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# BULLETIN

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## RELATIONS OF IRRIGATION TO GEOGRAPHY.

A LECTURE BY


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U. S. Geological Survey.


The relation between Irrigation and Geography seems at first so distant as to render it scarcely evident why a geographic society should be addressed on a purely engineering and agricultural subject. Until within the last decade the half of our great West, a third of the United States, was almost devoid of men and the works of man, outside of limited and widely separated areas in the mountains, where the pursuit of mining flourished. The plains and deserts were uninhabited but for the scattered herds of the ranchman.

All this is rapidly changing; villages are springing up in the desert; the centres of population are moving from the mountains to the plains; numerous roads traverse what was but recently the so-called Great American Desert. Railways and, best of all, canals of life-giving water thread the plains in various directions. All this because we have discovered that where before we had the land, and far from it in the mountains the water, the union of these can transform the former, even in its most forbidding aspects, into a veritable garden spot. Irrigation will, in the next century, entirely change the geography of the great West, and many of the blank spaces on the map will be more densely covered with village names than are similar areas in our East. It seems but proper, therefore, that a geographical society should know something of the art which is producing such stupendous results.

The word "irrigation" may imply to you a condition far more imposing than is intended. In dry weather your neighbor takes a watering pot and sprinkles such of his plants and flowers as he con-

siders most valuable, while, perhaps, with the hose or water barrel he moistens more or less of his garden truck. This is irrigation pure and simple. The only difference between this form and that more generally implied by the word irrigation as used in the arid West is, that in the latter region the application of water to the crops becomes a business by itself, and the farmer and the engineer unite in studying out methods whereby water may be applied in the easiest, least expensive and most certain manner. This is by aid of the action of gravity, and irrigation by natural flow is the result. Ditches are made which lead the water from the source of supply, be it well, reservoir or stream, and they are so aligned and graded that the water shall flow through these and from them into minor channels, and from these again it is led by ploughed or drilled furrows through the cultivated fields.

The mistake is too commonly made of regarding the work of irrigation as a hardship, and the necessity for it as a misfortune. In point of fact the necessity for irrigation and the ability to irrigate make a fortunate combination of circumstances for the agriculturist. The necessity for irrigation implies a warm, dry climate, as that of the arid regions, and this means that the crops are not liable to destruction by sudden, violent storms, nor by the lack of sufficient sunshine, nor by the failure of water supply as sometimes results from dependence upon rainfall. These are the conditions which prevail in the West. All of this fortunate combination of circumstances is not found in the semi-humid region, where the rainfall is usually sufficient, and there is, therefore, not the ever-present sunshine and the immunity from damaging storms; yet here irrigation may fulfil one of its most important functions, that of helping nature over the drought periods.

Even where irrigation is not essential to the production of crops, as in the Central and Southern States, there come occasional years of drought when crops which give promise of the most abundant yield are suddenly injured by an unusual period of dry weather. At such times had the farmer the power to supply the moisture which nature has failed to give, he would be able to tide his crop over the dry period and thus to protect himself against an almost certain loss. Irrigation may thus be regarded as a form of insurance. Every business man insures the contents of his store; why should it not be equally profitable for the man who depends upon the product of the soil, which in itself is dependent upon the moisture supplied it, to put an insurance policy on his crops? The farmer's house or his barn are probably far less frequently destroyed by fire

than are his crops by drought, and yet the loss in the latter case is even more serious than in the former.

For convenience in referring to the lands of the country in irrigation parlance, those of the extreme West are usually called "arid," those between theMississippi Valley and the Rocky Mountains, where the rainfall is nearly sufficient to insure the crops, are spoken of as "semi-humid," and the lands to the east of these are usually referred to as "humid," being those on which the rainfall is sufficient for the protection of crops. Yet this distinction is, to a certain extent, arbitrary, as it depends largely upon the amount of mean annual precipitation. The true distinction between arid and humid regions is dependent rather upon the amount of precipitation during the crop-growing season. In the humid regions in one season out of three the crops are short, the result of unfavorable climatic conditions. The farmer is, consequently, unable to get the maximum product each and every year from his land, and therefore is compelled to cultivate greater areas than he is really able to handle to the best advantage.

Where, as in the arid West, there is an abundance of good soil and plenty of sunshine, and the farmer can apply water just when and as he will, the tilling of the soil becomes a science. It is possible to learn precisely the amount of water required for different crops, and accordingly to produce the maximum output from the minimum areas. As a result, where irrigation is most successfully practised, as in Utah and southern California, the farms are of the smallest size. The average area of an irrigated farm in the State of Utah is twenty-three acres. The average size of a California farm is seventy-three acres, yet the majority of farms in southern California range in cultivated crops only from ten to thirty acres in extent. From such small areas as these farmers are able to produce such abundant yields as to enable them to live with an ease and comfort not known among the smaller farmers of our Eastern States. Another advantage gained by irrigation is in the ability to diversify crops. This is a matter of greatest importance in the Southwest, where the farmers are able to produce but few crops; had they the assurance of sufficient water supply at the time when vitally needed, they might cultivate many of the more valuable fruits and vegetables which are not now found profitable.

Irrigation is not only practised in the arid and semi-humid regions; it is extensively employed in regions of considerable rainfall. In Italy there are about 3,700,000 acres of irrigated lands, and in France a half million of acres. In these countries the annual rain-

fall is nearly as great as in the Eastern States. While the precipitation is ample in Italy and France for the production of ordinary crops, irrigation is practised to increase the yield and offset the consequences of drought. The general impression that irrigation is useful only in arid countries is entirely erroneous. It is such regions as the semi-arid plains of Kansas, Nebraska, Oklahoma and eastern Texas, which are especially in need of irrigation. Here occur usually a series of wet seasons when the rainfall is sufficient to produce abundant crops. At such times immigration is at its maximum, settlement is rapid, and buildings and fences are erected, and the farmers spend their all, as well as mortgage their property, in the hope of gaining a livelihood. Then comes the period of drought. One or two successive seasons of half crops render the inhabitants destitute; they lack the means to pay their debts or purchase food, and were it not for our magnificent transportation facilities and the charity of our people, most woeful famines would devastate these countries. The consequences of drought in the East are not so serious, yet their effect is to render the farmer less prosperous and his life a harder and more laborious one than if he were protected by irrigation.

The history of agriculture by irrigation is as old as the history of the world. History begins in the Valley of the Nile, yet that valley has been irrigated since earliest times. The first agriculture in Europe, Asia and Africa began in arid regions, where irrigation was practised as an essential. In our own country the early Spanish explorers discovered the remains of irrigation works, showing that agriculture by this means was practised by the Aztecs. The remains of their canals and irrigation ditches are to be seen still, in a fair state of preservation, in many parts of the Southwest. The earlier American irrigation works were designed in a haphazard manner by county surveyors, or by railway engineers who possessed little knowledge of the principles of hydraulics underlying the subjects with which they were dealing. Recently the practice of irrigation has developed into a special science, and there has gradually grown up a vast amount of information regarding the branches of engineering most nearly allied to irrigation. As a separate branch of engineering, irrigation first received recognition in India, where a corps of irrigation engineers was first organized about forty years ago, at the time when the British Crown assumed control of that country.

According to the Census Reports the average size of irrigated farms in the United States is sixty-eight acres, and the average

value of the product per acre in 1889 was a little less than $15. This gives no real index to the actual value of some of the crops which are produced by irrigation. Farming with the aid of irrigation is more lucrative—though more expensive—than farming without it. The first cost of land without water supply depends upon the locality. It ranges from $1.25 per acre to from $10 to $25 per acre where the crops and lands are more valuable, as in limited portions of Colorado, Utah and California. The average cost per acre of developing an irrigation plant ranges from $4 in Idaho and Montana, to $10 and $15 in Utah, Colorado and California. The average annual cost of supplying water, per acre, in other words, the average water rental paid by the farmer, ranges from 75 cents to $2, though it is much more expensive than this in some portions of southern California. To these costs must be added those of preparing the land for cultivation, such as clearing, fencing and ditching it. Yet in spite of this apparently large outlay—$5 for land, $10 for irrigation plant, and $2 per annum water rate—lands so made irrigable are at once valued at anywhere from $30 to $100 per acre, while their annual output is frequently as great as these figures. Thus we find that the average annual value of the products per acre of irrigated lands ranges from $15 in the Northwestern States, to $25 or $30 per acre in Utah or Colorado, and up to $500 per acre in California. In the latter region peach, apricot and prune orchards frequently return $100 to $150 per acre. The yield of raisin grapes is often worth from $200 to $250, and of oranges and olives from $300 to $500 per acre.

Let us now examine more carefully the parts which go to make up an irrigation system. Beginning with the rainfall from which the water supply is derived; the mountains in which it is conserved in lakes and gathered in streams to feed the canals; the reservoirs in which it is sometimes necessary to store it; and the main canals which conduct these waters to the irrigable lands; we will then glance at the methods of applying the waters to the soil, at the lands available for irrigation, and at the crops which result from this union.

The true index to the amount of precipitation available for irrigation is not the actual recorded precipitation, but the percentage of this which flows off into the streams and which is known as "run-off." This quantity differs in various portions of the country with the slopes, the flora, the temperature and the soil. A glance at a run-off map of the United States shows in the darker shade of color that portion in which the run-off exceeds 20 inches in depth. This,

it will be observed, is in the eastern and southern portions of the country, in the Cascade regions of Washington and Oregon and in limited areas in the Rocky Mountains. There irrigation is unnecessary because the quantity and distribution of precipitation is sufficient to mature crops. Throughout the desert regions of Arizona, Utah, Nevada, Oregon and Idaho, and in portions of western Kansas, Nebraska and Texas, the run-off is less than two inches. There, not only is precipitation too small to mature crops, but the amount of run-off is too small to furnish supplies for irrigation. The major supplies for irrigation waters in the arid regions are to be derived, as shown by the run-off map, from the great mountains of the Pacific Coast and from the Rocky Mountains in Colorado, Wyoming and Montana, as well as from limited areas in others of the Western States.

One of the best typical irrigation basins of the arid West is that including the drainage of the Arkansas River in Colorado. Your attention is called to it because it illustrates well how use may be made of all the waters of a drainage basin for the irrigation of its agricultural lands. The Arkansas River rises among great mountain peaks, ranging from 12,000 to 14,000 feet in height, capped with perpetual snow. The lower foothill slopes to the east of the mountains are irregular in shape, covered with a scattered growth of scrubby timber, and furnish excellent grazing for cattle. Among these foothills are numerous sites suitable for the construction of reservoirs, in which to store the surplus water that comes from the higher mountains and retain it until needed for irrigation during the cropping season. To the eastward of the foothills is a great area of gently rolling land, well suited for the raising of all crops which will grow in the climate of Colorado. Through this the Arkansas and its tributaries have eroded deep channels, and it is therefore necessary in order to conduct the irrigation waters to the lands above these, to divert the waters of the river by canals heading in the foothills and lead them on suitable gradients to the plains below.

If we observe the character of the higher mountains, on which the rainfall is great and which furnish the ultimate source of supply of irrigation waters, the steepness of the barren rocky slopes shows clearly that the greater percentage of the precipitation in such a region runs off to the streams, as it would have no opportunity to lie quietly and evaporate, or percolate into the ground. The little streams which gather the water in these mountains connect together in rushing mountain brooks flowing over steep and

pebbly beds, and these emerge from the mountains on to the foot hill slopes in broad and shallow rivers, the waters of which, if not diverted into canals for irrigation at these points, quickly sink into the ground or are evaporated, leaving the river beds practically dry but a few miles further on. An examination of a diagram showing the discharge of such a river, the Arkansas for example, gives an idea of the irregularity of its flow. From January to April its volume is practically uniform, as it is from August to December, the discharge being approximately 500 cubic feet per second, but between May and August, the period in which the snows are melting in the mountains under the influence of warm rains, the volume of the river rapidly rises to a maximum at the end of June of 4,500 cubic feet per second, nine times that which it normally has. It is this great volume of water which it is desirable to conserve in storage reservoirs, otherwise it rushes off in floods to the ocean and is lost to irrigation. It is to preserve this water until it is wanted by irrigators that storage reservoirs are built.

On the flat plains country to the east of the Rocky Mountains, in Kansas, Oklahoma, etc., the occasional precipitation either sinks into the soil and is thus lost to agriculture, or it occurs in violent storms of short duration and rushes as a flood over the entire surface of the land, falling into the streamways over steep banks which are eroded by its action. At times the volume of this surface run-off is so great as to produce temporary waterfalls of giant proportions, and it can be readily realized that such falls rapidly wash away the banks of the ordinarily dry streams.

Let us glance now at the character of the irrigable lands. In western Kansas, Nebraska and Texas we find a flat prairie land which produces an abundant natural growth of grass, but here the rainfall is insufficient or is so poorly distributed as to make agricultural pursuits hazardous without the aid of irrigation. Here the soil is deep and fertile, water alone being required to make it productive. In New Mexico we find rolling plains, the slopes covered with short bunch grass, juniper bushes and sage brush, the surface practically barren of vegetation and exposing a sandy or loamy, barren soil. This is among the most fertile of the soils of our country when water is applied to it, and is capable of producing the finest varieties of all valuable fruits and vegetables. In Arizona, Utah, Idaho and Nevada, the best agricultural lands are the great level, sandy and barren plains covered with occasional scattered bunches of sage brush. Here rainfall is entirely inadequate to the maturing of crops, but when artificially watered this soil is equally

as productive as that found in other portions of the arid regions. An idea of the fertility of this soil may be readily gained by a glance at some of the thickets of cacti which flourish in all the southern portions of this region, plants which mature in the most barren country and without rain or other watering.

In addition to the surface water supplies, those derived from run-off from streams or conserved in storage reservoirs, there are large volumes of sub-surface water ; water which has filtered or percolated into the ground, whence it may be got by digging wells or boring artesian wells. In the West are some great artesian basins, notably those of the Dakotas and Texas; the Carson Valley of Nevada, and the valleys of southern California. Here numerous artesian wells are bored and furnish such volumes of water as provide for the irrigation of considerable areas of land. As these wells flow continuously, while irrigation is practised intermittently, it is therefore found advantageous to build about them storage tanks or reservoirs in which the water may be conserved or collected until wanted in irrigation. Some of these storage reservoirs are made most beautiful, especially in southern California, by planting about them palms, lilies and other tropical plants which flourish luxuriantly under the genial sunshine of that clime and the beneficent moisture of the artesian waters. Others of these reservoirs are quite extensive and are supplied by large wells, or numbers of wells, and have been so beautified and arranged as to produce picturesque lakes.

Irrigation, as originally practised in Asiatic countries, consisted chiefly in pumping water out of wells and pouring it into small ditches which carried it to the irrigated fields, or more expeditiously in bailing it, as it is called, by two men swinging a wicker basket between them in such a manner as to toss the water from the stream into the irrigating ditch. Again, it is raised from wells by the "shadoof" or "pakota," which is simply our old-fashioned well-sweep, several of these being sometimes arranged in a series of steps one above the other, the water being lifted from the lower level and emptied into a trough above, whence it is raised by the next higher well-sweep through a further elevation until it ultimately reaches the ditches which conduct it to the fields.

Pumping is also practised in our own country, especially in the plains region, where there is a constant and regular wind supply, and well water or water from shallow streams is raised by various forms of windmills. Sometimes by the old-fashioned windmill, which lifts the water from its lower level into ditches which flow above the surface. More commonly we find modern windmills, and

these are provided with storage reservoirs as are artesian wells, so that the mill may be run whenever the wind suffices, and store up water for use when wanted in irrigation. Again, on flowing streams water wheels are employed to pump a portion of the volume used in producing their power to higher levels for irrigation. Still again, steam pumps, not infrequently of large size, lift water continuously to storage reservoirs, whence it is conducted to the irrigated fields.

And now we turn to the main sources of supply for irrigation, the surface waters. In the mountains, that volume of water which flows off during flood seasons is caught in great reservoirs or artificial lakes where it is stored until required for irrigation, and then it is liberated and flows for many miles down the mountain streams until it reaches the neighborhood of the irrigable lands, where it is diverted in ditches. A glance at one of the localities in which such reservoirs are constructed gives us an idea of the kind of mountain valley best suited to their uses. A great dam is built across the confining hill slopes at the foot of the valley, thus forming an artificial lake which will store large volumes of flood water. The building of such a mountain dam is an interesting process. It may be constructed of earth or of substantial masonry, or, as is not uncommon in the higher and less accessible mountain region where labor and transportation are expensive, a cribwork is constructed of logs, cut in the immediate neighborhood and weighted down with heavy rocks to hold them in place. One of the most magnificent and substantial storage reservoirs in the West is that formed by the Sweetwater dam in southern California, a massive masonry structure which bars the rocky outlet of a broad valley. Great care and skill must be exercised in constructing such a dam, for be the engineer's calculations of flood volume ever so liberal, a flood may occur of such volume as to fill the reservoir and top the dam, as in the case of the Sweetwater dam, but fortunately without causing its rupture. In building a masonry dam to withstand such hydraulic forces the foundations must be dug deep and well, so that the masonry may rest on the most substantial and homogeneous rock, far below the natural surface of the ground.

The waters stored in these mountain valleys are conducted sometimes directly by ditches to the irrigable lands, at other times are passed back into streams and again diverted therefrom lower down. In the valley of the Arkansas in Colorado are numerous irrigating ditches diverted from that stream. Some of the flood waters of the stream are conserved in the mountains in reservoirs, whence they are liberated when needed, and flow for many

miles down the Arkansas to the neighborhood of Pueblo, where the stream leaves the mountains. From there on down the stream numerous ditches are diverted, which climb in long and tortuous curves away from the river banks until they reach the upper and more level plains lands. From these ditches are then taken other and smaller channels which irrigate the fields, or, not uncommonly, they discharge much of their volume into reservoirs constructed on the plains lands where it is stored until it is wanted for irrigation; so that a double system of storage is practised, that of the mountain waters which are retained in time of flood, that from ditches which are permitted to run full at all times of the year, though the waters which they carry are utilized but occasionally during the summer. The plains reservoirs are often quite numerous, dotting the uplands in all directions. They are natural hollows or lakes on the plains, ordinarily dry or filled with alkali water, but when utilized as reservoirs filled with good, fresh, river water. A cheap earth dam is constructed at the outlet of these, supplemented by a cut which reaches to the level of the bed, and thus enables a large volume to be retained within them and allows this to be easily withdrawn. Some of the plains reservoirs are quite picturesque, forming pretty lakes in the landscape, and often they are of such dimensions as to be utilized as fish ponds and enjoyed by pleasure seekers in row and sail boats.

The waters which flow through the great rivers of the plains can only be diverted from these by means of great ditches, weirs and dams of expensive and difficult construction, built to withstand the eroding action of the immense volumes of water which assail them. The Arizona dam, on the Salt River in Arizona, has had to withstand the erosive action of floods greater than the discharge of the Potomac or Hudson or even that of the Mississippi River, yet in ordinary seasons the discharge from this stream is so small as to scarcely fill the canals which are diverted from it. These dams are usually built at the points at which the streams debouch from the hills to the plains. At one end of such a dam heads the supply canal, which is usually constructed at great expense by difficult excavation in the rocky slopes of the mountains, until it finally emerges from their confining walls and finds its way by winding curves through the irrigable lands of the plains. In order to control the admission of the river water into the canals at the point of stoppage of its flow by the dam, there must be built in the head of the canal great regulating works or gates, which may be lowered or raised according to the amount of water which it is desirable to

permit to enter the canal. An excellent example of the relation of the head gates to the canal, the supplying stream and the dam, is that furnished by the Folsom canal, diverted from the American River in California.

The diversion line, as it is called, of some of these canals—by which is meant that upper portion of its line which is built merely to get the water from the river to irrigable lands, and not that portion which is doing active work in irrigating the fields—is usually the most difficult and expensive portion of the canal to build, as it has to cut through rocky slopes, tunnel ridges and be carried across ravines in flumes or pipes. The construction of such canals is an interesting and expensive operation according to its size. It may be so small that the excavation can be made by hand. In California not uncommonly the hydraulic monitor is employed in excavating the canal line and water itself is utilized in digging the channel through which water is later to flow. One of the greatest canals in the country, the New York Canal in Idaho, was constructed rapidly and with a large force of men, working with modern tools, ploughs, scrapers and excavators. In flat valley country, as in the Sacramento valley in California, canals have been simply and cheaply constructed by great steam dredging machines, the work being executed on a scale commensurate with its magnitude.

Some of the cuts which must be made in excavating these canals are deep and difficult, as that on the Payette canal in Idaho. Again, the water is conducted around rocky slopes in wooden flumes built against the rock walls; at other times, that its grade may be maintained, it is carried across creeks and ravines in similar flumes, and even after it reaches the level and more gently sloping irrigable lands it has to be carried across side drainage lines in flumes of similar construction. The building of such flumes is a work of no mean magnitude, even when they are made throughout of wooden timbers, as is the more common practice; while others have been most substantially constructed, as those of the Santa Ana Canal, not of wood but of iron, resting on iron piers, the iron or steel framing being lined with wood. In India, where are to be found the greatest of all irrigation works, these have usually, in accordance with British methods, been built in the most substantial manner, the flumes or aqueducts being of massive masonry. The largest of these in the world is that in which the Ganges Canal is carried across the Solani River; the canal at this point being 270 feet in width on top and ten feet in depth, a stream which far exceeds in magnitude the Erie canal and in fact many of the rivers of our country.

Instead of in flumes, water is sometimes carried across ravines in what are called "inverted siphons," or more properly "pressure pipes," which are wooden pipes constructed much like a continuous barrel, bound with iron hoops, and through these the water flows down the hill-slopes on one side and up the other; the down-stream end being necessarily lower than the upper or inlet end that the pressure from the latter may be sufficient to force the water through the pipe. Again, the line of these diversion canals may be blocked by ridges which must be tunneled, and in some cases there occur, as on the Bear River Canal in Utah, two or three such tunnels following each other in quick succession.

Finally, the diversion line emerges from the confining hills, and the canal is now a broad and limpid stream, well graded, which meanders slowly through the gently undulating plains which are to be irrigated. Sometimes the slopes are so even that the canal may be carried as a direct line, a beautiful, straight, silver stream, through the immense valley. In the banks of such canals are built, at occasional intervals, gates of wood or masonry, through which the water can be passed into smaller or minor canals and ditches which lead it to the irrigable fields, and from these it is discharged into still smaller channels which distribute it over the land. Some of these smaller irrigating ditches are excavated at considerable expense, and those taken from the larger canals are often works of quite as great magnitude as the main canals taken from smaller streams. As these canals pass through the plains, it not infrequently happens that the slopes of the plain are greater than the permissible slopes of the canal, for if the slope of the canal were too great it would erode its banks; there are, therefore, at intervals in these canals, falls by which the water is lowered with a single drop from one level to another, and it is usually just above such falls that the branch canals are diverted. In southern California, where water is more valuable than in the plains region, because of its scarcity and the value of the crops it produces, it is not allowed to flow through channels excavated in the earth, as much of its volume would be dissipated by percolation into the ground and by evaporation from the surface. Here it is conducted through narrow and deep channels lined with masonry to prevent its loss.

Ultimately these minor ditches reach the fields, and there the water is again checked by regulating gates which turn it in greater or less volume, as may be desired, into the slightly smaller channels from which it is flowed over the land. The processes of irrigating the land from these minor channels vary according to the crop, the

soil and the slope of the land. In some portions of the West, especially in Wyoming, Montana and the mountains of Colorado, where water is comparatively abundant and the climate such that hay and grain crops can be successfully produced, water is handled wastefully by being flowed over the entire surface of the field at each irrigation. In such cases a break is made in the bank of the ditch whence the water is conducted and coaxed by the use of a hoe in such manner as to lead it in a uniform sheet over the entire meadow. After it has flowed for perhaps a day it is stopped off and permitted to soak into the soil. Two or three, perhaps four such irrigations in a season, are sufficient to produce as many heavy crops of hay. Again, instead of breaking the banks of the irrigating ditches, a more common practice is to use a "check" or "stop" of some kind in the ditch. Not infrequently a curtain of canvas, weighted with a clod of earth, is dropped into the ditch, thus forcing the water back over its banks whence it floods the grain fields.

The more effective way in which to use water in irrigating is by flowing it through drill rows or furrows, ploughed sometimes with a single cultivator, but occasionally on a larger scale with great steam gang-ploughs. In these furrows or drill rows are planted the various crops, and through them flows the water which moistens them. It is not possible to irrigate grain or hay in this way, because the rough, furrowed surface would prevent its being mowed with machinery; so that hay or grain crops, where intelligently handled, are irrigated through shallow rows made by the drilling machine which sows the seed, and these do not cause the surface of the ground to be any more irregular than they do in the East, where irrigation is not practised.

Potatoes, cabbages, corn and similar crops, however, are planted in deep-furrowed rows, made by ploughing the land with a plough the share of which is V-shaped, and does not turn the earth in one, but in both directions. Crops are planted on the intervening ridges, and through the furrows flows the irrigating fluid. Fruit crops are sometimes irrigated by running several rows of shallow furrows between the trees; through these pass small streams of water which, flowing rapidly, percolate well into the ground and moisten the roots of the trees from a distance, and deeply, thus producing the most desirable effect, that nearly approaching a steady moistening by a soaking rain. A less satisfactory, but quite common way of irrigating trees, is by running a couple of ditches, one on either side of the trees and nearer to them, and from these the water seeps into the ground and about the roots. On steep

hillsides the ground is levelled off in terraces, as in the foothills of California, and the water is flowed through ditches on the upper terrace, settling in basins constructed about each tree, and when these basins are full and the water has stood in them long enough to soak the ground it is drawn off into the next terrace and series of basins below it, and so it flows on down hill, watering terrace after terrace in its progress.

The products of irrigation unquestionably exceed in amount and quality those produced under the vicissitudes of natural conditions. Sunshine is ever present, the soil chosen is always the best, water is applied just when wanted, and the result is to bring about practically such conditions as exist in a hothouse or conservatory. Such a crop of potatoes as is ordinarily gathered in the irrigated fields of the arid West cannot be harvested in the humid East. The cabbage crops of the same region are equally luxuriant and abundant. In irrigated cornfields the stalks far exceed in height and in verdure those of unirrigated regions, while an average of two or three ears of enormous size is produced on each stalk. The crop of an irrigated wheat field, where the water is intelligently handled, may, like all other irrigated crops, run to leaf or to grain, according to its treatment. Where properly handled, the leaf and stalk, in other words, straw, will be least in amount and the grain greatest.

The art of agriculture by irrigation is quite as different from the art of agriculture in humid regions, as is the act of irrigating land different from the act of cultivating without irrigation. Abundant as are the grain and vegetable crops of irrigated fields, the hay crops are equally luxuriant, but probably none flourish with such luxuriance under irrigation as do the grape and citrus fruits. I can conceive no more beautiful sight than a well-irrigated and well-laid-out vineyard, such as may be seen extending for miles in southern California; and no more attractive objects than the raisin, prune or apricot drying beds of a California farm at the close of the season.

In conclusion, a brief review of the processes of irrigation, and the wonderful transformations wrought by it, may be got from a study of a typical vineyard in Kern Valley, California. The case here chosen represents a period of four months; in March the field was ploughed and the ditch excavated; in May the vines were sprouting from the cutting, and by July they have attained full growth and are producing the first scanty crop of grapes. Thus irrigation, as by magic, gives constantly changing views, and our geographies must in part be rewritten to keep pace with the marvellous development of our great, arid West.

# FROM CAIRO TO BENI-HASSAN.

BY

D. CADY EATON.

About ten miles south of the pyramids of Gizeh is Sakkara, and about three miles south of Sakkara is Dashur. Sakkara and Dashur are at the edge of the desert. Between them and the Nile is supposed to have been the heart of the great city Memphis, whose limits are unknown. From north of the pyramids of Gizeh to south of Dashur stretched the necropolis of Memphis. The ruins of tombs and pyramids are everywhere. Most of the abodes of the dead were ransacked and plundered centuries ago. Now and then one is found intact and as it was sealed up by surviving relatives three, or four thousand years before the Christian era. The tombs of Ti, Pthahotep and Sabu were discovered during the present century. The tomb of Mera was discovered in 1893. Two years ago three tombs of princesses of the Aménema family of the XII. dynasty were also discovered. Over three hundred tombs were excavated by Mariette. Active search is still kept up. Any day news may come of new discoveries which may shed light on vexed questions and start new ones.

The best way to visit Sakkara is in a sand cart from Gizeh. These carts, which are quite comfortable, are made with very broad wooden tires which prevent the wheels from sinking into the sand. With a good donkey harnessed to the cart you can make the distance in about two hours.

Before examining tombs, a brief statement of the ideas held by the ancient Egyptians about death and the dead may serve as introduction. The poor seem to have been regarded as cattle. A shallow trench and a scant covering of sand sufficed for the burial of their soulless bodies. But the rich and the mighty were immortal.

Generically stated, the Egyptians believed that at death body and soul were separated, to be reunited at some distant time; and that the body must be preserved so as to make possible the reunion. No satisfactory idea of the details of the processes can be had. Documents are few; those who have studied them do not agree. Some points, however, seem partially established. The soul, or living principle, or whatever you choose to call it, was composed

of several parts. First in importance was the "Ka" or double. Exactly what the "Ka" was is obscure. When a king is represented, his "Ka" may be represented also; as in a relief, in the temple of Der-el-Bahri in the neighborhood of Thebes, where Queen Hatshepsu, who was an advanced woman and always appeared in male attire, is making offerings. Immediately behind her is her "Ka," resembling her in form and feature, but of only about half her size. Then again the "Ka" is represented simply by a two-armed staff bearing another staff, as in a relief in the temple of Abu Simbel near the second cataract. The relief represents the great Ramses II. cutting off the heads of a handful of his enemies. In front of, and facing him, is the hawk-headed god Horus offering him something better to cut off heads with. Back of him is his "Ka," symbolized by a two-armed standard surmounted by a hawk crowned with the double crown of upper and lower Egypt. In one of its hands the "Ka" standard holds a staff which is surmounted by a representation of the King bearing on its head the upraised arms which form the "Ka" sign. The double crown on the hawk's head looks for all the world like a champagne bottle in a champagne cooler. The champagne bottle, which is always white, is the crown of upper Egypt; the cooler, which is red, is the crown of lower Egypt.

That ideas about the "Ka" were vague is evident from a relief in the temple of Amenophis III., at Soleb, away up the river, in the centre of Nubia, where nobody goes nowadays. Amenophis, or Amunoph III., was of the XVIIIth dynasty; that is, he lived, flourished and reigned about 1500 years before Christ. He was a great conqueror, and annexed Nubia to Egypt. In the relief, according to the hieroglyphic inscription, he is represented making an offering to his "Ka," that is, to himself deified, as if no divinity could be superior to his own personality. The "Ka" replies: "I give thee all life, all stability, all power, all health," &c., &c. Such instances of inordinate self-adulation and unblushing self-adoration are common to every part of Egypt and to every dynasty. Humility and self-abnegation were unknown qualities in Egyptian royal families.

A relief in the temple of Amenophis III., at Luxor, shows the "Ka" in another form. The scene represents Amenophis, when a child, presented with his "Ka" to the god Amen Ra, in the first place by the hawk-headed Horus, or Harmachis, and in the second place by two lesser divinities, who represent the River Nile. Here the infant and its "Ka" are precisely alike. Children are almost

always represented with a finger in the mouth, and a thick, curled lock of hair over the ear.

The effort to make of the "Ka," or of any other Egyptian idea, a complete and logical entity for the understanding and acceptance of the modern mind may amuse and interest psychologists, but the task should not be attempted by sensible, everyday people. A very old belief about the "Ka" was that after a man's death his statue attracted his "Ka," and the more statues there were, the greater the "Ka" power, or the number of "Kas," attracted. This accounts for the great number of statues of a king found in his temple. The gods also had "Kas." The great god Ra had fourteen "Kas." The "Ka" is a puzzle even to the erudite.

Next in importance to the "Ka" was the "Ab," or heart, regarded as the principle, or source, of human life. At death the "Ab" returned to heaven, its source; and stayed there till the deceased reached the hall of judgment in the lower world. There it appeared as a witness for, or against, him. If the verdict were favorable, the "Ab" rejoined the deceased, who then became immortal. In order that some kind of life be preserved in the mummy, the mummy must be provided with a substitute for the heart,—with a provisional heart. This provisional heart was a large, artificial scarab. The underside was flat, and on it was engraved a prayer, or invocation, to the heart itself, beseeching it to be kind and merciful when it appeared in the hall of judgment.

Another immortal ingredient was the "Ba," or spirit, a conception nearly corresponding to our idea of the soul. It was represented at times as a human-headed bird; at other times by a ram-headed scarab. The "Ba" is often perched on top of the mummy, as if bidding it good-bye before departing for the home of the gods. The "Ba" could, and often did, revisit the mummy, and on those occasions expected to find offerings of food and drink for its acceptance and use. The representation of a "Ba" flying down the shaft leading to the underground tomb of the mummy, for the purpose of making it a visit, is very frequent, and is almost always found in the copies of the Book of the Dead. The notion of representing the soul as a bird or as a child, with or without wings, is common to many nations, and is not repulsive to Christianity.

There were two other entities which made up the immortal man: The "Khaib," or shadow, represented by a fan; and the "Sahu," which seems to have been a species of immortal outline or exterior. It is no wonder that the poor Egyptian, with so many things inside of him, should have become confused when attempting to discrimi-

nate and describe. That modern investigators share his confusion is most natural. The Book of the Dead, in which these various components appear, and which is the source of information on the subject, is most confusing.

Maspero, after having devoted years to its study, still frankly confesses that he does not understand it.

There was still another thing, and a very important thing, called Osiris. The Osiris corresponds to our ghost and the Greek shade. The Osiris is the thing which goes below and is subjected to the trials of the Egyptian purgatory. The Osiris resembles the deceased and retains his character and disposition. Osiris is, at the same time, the name of the great sun god, husband of Isis and father of Horus, who was killed by his wicked brother and thereafter became the king of the next world. The fact that each shade that appears before him is called by his name adds still further to the difficulty of obtaining clear views of Egyptian thanatology.

There has lately appeared a small book by Professor Wiedemann, of the University of Bonn, in which the Egyptian doctrine of immortality is made as clear as, I suppose, it can be made. At all events, I have accepted his views in preference to those of other more elaborate and more pretentious authors. Read the book—it is in every library,—and has been translated into many languages.

Egyptian tombs may be partially, but not strictly, divided into three classes,—the pyramid, the mastába, and the gallery. Of the pyramid you are supposed to have been informed at Cairo. Next comes the mastába.

That the mastába had its origin in the pile of stones which primitive man threw up over the grave of a chief may be accepted. The word mastába is modern Arabic, and means bench. The word was applied by the Arabs on account of the long, low and comparatively narrow form of the buildings. The mastába consisted of a quadrangular mass of stones and rubbish enclosed within hewn walls, and covered with a pavement of hewn stones. Mastábas vary in length from 25 to 150 feet, with proportionate breadth, and are from 10 to 25 feet high. The walls incline slightly on all sides. This has caused some investigators to suppose that mastábas were the beginning, the cores, of pyramids. From the top of the mastába down through it to the rock on which it was founded, and then down through the rock, was a square or oblong shaft reaching from 20 to 75 feet. Sometimes there were two shafts. At the bottom of the shaft was a narrow passageway, which soon enlarged and expanded into the sepulchre chamber, where the sarcophagus was

placed. When the funeral rites were finished, the entrance to the passageway was sealed by a huge stone; the shaft was filled up with stones and rubbish; its mouth was closed by a slab not to be distinguished from the other slabs about it, and the dead was left forever to the tender mercies of its "Ka," its "Ab," its "Ba," and its other immortal compounds. Most mastábas have their longer axis running from north to south. Some are solid throughout and have nothing to indicate the use to which they are put, but most have, at least, a high, narrow and shallow opening in the east side near the north, terminating with the semblance of a door. This door represents the entrance to the infernal regions, through which the deceased has passed, and through which no living being can follow. In the larger and finer mastábas there are, in addition, vestibules, supported by square columns, without plinth or abacus, and at the bottom of the vestibule a door leading to one or more chambers. No exact plan is followed. The vestibule and chambers are sometimes on the south side, more often on the east side, generally on the north side, never on the west side. The mastábas of the first three dynasties have but one chamber. Those of the fourth and fifth dynasties may have many. After the sixth dynasty mastábas disappear and do not recur in Egyptian history. Mastábas of the very earliest date are supposed to have borne no inscriptions or reliefs, but nearly all so far discovered have, at least, the representation of the gates of the under world, while mastábas of the fourth and fifth dynasties are rich in inscriptions and in diversified ornament.

Apart from the main chamber, where the family met for funereal services and banquets, the mastába contained another and a small chamber called a sirdab, which only communicated with the other chamber by a narrow slit high up in the wall. The sirdab was the dwelling of the "Ka." It contained statues of the deceased, which were supposed to be filled with the essence of his "Ka," and through the slit was wafted to the "Ka" the fragrance of offerings made in the larger chamber.

The exterior narrow opening already mentioned was for the exclusive entrance and departure of the "Ab," or soul, when it chose to visit the mummy. The doors to the lower world were only attached to this opening when it was the only opening in the mastába.

When the traveller gets back to the boat at Bedrashen he will probably be so overcome with fatigue, heat and dust that even the slender comforts of a Cook steamboat will seem paradisiacal. After

being thoroughly washed, reclothed, fed and restored to a right mind, he may be in condition to look over those pages of the Paris "Illustration," wherein a clever French artist has depicted triumphs of excavating achieved by M. de Morgan, who is at one and the same time the head of the French School of Archæology at Cairo, and the chief of the governmental department of antiquities; at least, that is about as well as his position can be described amid the complications of Egyptian government. Though the French politically have been supplanted by the English, they seem archæologically still to be on top.

M. de Morgan, in pursuing his investigation, hit upon the clever scheme of being governed by soil indications. He first made repeated borings, so as to become acquainted with the character of the soil at different depths. If, then, he found on the surface of the ground soil that was not surface soil, he followed it like a trail to the spot where the trail stopped. There, he surmised, was the spot where there had been digging for space for tombs, and where he must dig to rediscover the tombs. The scheme has worked admirably. He first applied his method during the early spring of 1894. His success has been wonderful. Many royal tombs have been discovered, and priceless additions have been made to the collection of jewels at the Gizeh Museum.

As the steamboats on the Nile do not steam at night, owing to the intricacies of the current and to shifting sandbars, it takes two days to reach Beni Hassan, the next regular stopping place.

The tombs of Beni Hassan, high up on the hillsides, are kept clean and in good order, and are part of the regular Nile show. They are neither mastábas, nor galleries. They have the sepulchral pits of the mastábas, but in place of the mastába itself is substituted a subterranean temple.

Beni Hassan is about 230 miles from Cairo. During most of the distance the mountains come up closely to the east bank of the Nile, but are from five to twenty miles away from the west bank, leaving a belt of most fertile soil. Here are the sugar plantations. A most odd Egyptian experience is to see rising on the site of a town of Ramses II. the lofty tower of a modern sugar refinery, belching forth its thick, black smoke to the confusion of meditations of the past. During the two days of steaming and casual stopping, you have ample time to examine the natives, who flock to the banks where your boat ties up; and to meditate upon their past, present and future. The regeneration of a fallen race is a topic of philanthropic theory, but history furnishes no instance of its accomplishment.

Races advance and then stop at a barrier, over which they cannot carry their peculiarities. Other races, far below them at the start, leap the barrier and pass on to some other barrier, which in turn stops them. In all history there is no one instance of a race recovering lost prestige and power. The torch of civilization must be held high, grasped firmly and ever advanced. If, in the history of the world, there was a time when such a creature as the present Egyptian was supreme in human rank, man, from our point of view, must have been a very poor and contemptible being. Modern Egyptians are extremely low in the scale of humanity. They gather about in helpless groups. They stare with far less intelligence than their donkeys. They squat. They allow themselves to be beaten with sticks, and to be driven about like dogs. When stirred to activity, their activities are vile. If any one succeed in accumulating money, it is used in the gratification of the lowest and most disgusting sensuality. Should England withdraw from Egypt the presence and weight of her authority, the country would lapse into barbarism and be as unsafe as the fighting ground of Kurd and Armenian. If the world is to be Christianized, it will be by the flowing of Christian races over its surface, and by the disappearance of those races which can neither apprehend nor embrace Christian principles. Of all enemies of Christian progress, the Mussulman is the most stolid and the most bitter. To convert him is as hopeless a task as to teach a tiger to use a napkin.

The women of the villages are not a whit more attractive than the men. The ordinary dress of the men is a cotton shirt, originally white; over it another cotton shirt, originally blue, and a white turban. The women are generally satisfied with one shirt, and a piece of cotton cloth, which is occasionally drawn over the head as a shawl. They are ignorant of stockings, stays and underclothes, and share their liege-lords' ignorance of cleanliness, modesty, morals and manners. Carrying water from the river is one of the labors they share with their mates. Their wretched fate seems to deprive them of even the solace of gossip. In villages of a thousand, or more, inhabitants, you may not find a house that is not made of Nile mud, or that has more than one room and one story; nor a street that is not a crooked rivulet of filth oozing down to the Nile. How people can survive a single summer of such existence is one of the mysteries of Egyptian Providence.

Sometimes the monotony of the voyage is relieved by the sight of a dahabiyeh, in which some English lord, or American millionaire, may be leisurely and most pleasantly doing the Nile. To a

party with cash, patience and leisure, life on a dahabiyeh, with well chosen guests, must be delightful. The drawback is, that you are dependent on the wind for locomotion, and may be becalmed for a month. Still, during the winter months, the winds generally blow from the north to help you up the Nile; and when once up, you may float down with the current.

On the third day after leaving Bedrashen, you are made aware that you are approaching Beni Hassan, by the assemblage of donkeys and donkey boys on the bank. The donkeys of Beni Hassan are well up in the rank of faithful and intelligent donkeys, and the Arab boys are not so bad as anticipated. The further the Arab is removed from Cairo, and from the influences of modern European civilization, the more tractable he seems to be. At Luxor, Assuan, and other large places where there are modern hotels, vice-consuls and American schools, the Arab is nearly as bad as he is in and about Cairo. Where he lives in the midst of his primitive filth and ignorance, he is a quiet beast till aroused by cupidity or revenge. Then he is like all other wild animals, and must be held in absolute subjection by fear and force.

To thoroughly explore and thoroughly understand the tombs of Beni Hassan, would take lengths of time and lengths of study. They were visited by the earliest explorers. Numbers of explorers have written about them, and almost every explorer has advanced ideas which subsequent explorers combat and demolish.

The tombs are excavated in the rocky hills which shut in the Nile Valley on the east, are less than two hundred feet above the Nile level, and are about two and a half miles northeast of the village of Beni Hassan, where the steamer stops. A stratum where the limestone was compact was selected. Its face was cut down, and cut away, so as to present a perpendicular surface, and at the same time to afford a horizontal platform of approach. Then digging commenced from the horizontal platform. Over thirty tombs have been discovered and cleaned out. The inscriptions on some of them are of the 12th dynasty,—that is, between about two and three thousand years before Christ. According to Biblical chronology, Joseph died in Egypt in 1635 B. C. So these inscriptions may be 1,500 years older than Joseph. Critics have hastily concluded that the tombs are of the dates of the inscriptions. For all the evidence at hand, these caves may have existed for other thousands of years before the notables of the 12th dynasty utilized them as tombs. They may have been the residences of primitive man at the geological period when the River Nile filled all the val-

ley below and reached up to the base of the hill where they are dug.

After being hurried through these tombs you long to return with time enough to examine from some point of view which even a rapid survey cannot fail to suggest. If the original caves were enlarged at subsequent periods, there must be indices, as in a Gothic cathedral, to distinguish the work of one period from the work of another. The nearness to one another of the adjoining walls of any two of the larger tombs, in comparison with the greater distance between the smaller tombs, may suggest the idea that the nearness, in the first instance, is the result of a broader enlargement of the original excavations.

Thirty-nine tombs have been investigated. There may be many more both to the north and to the south, not yet discovered, and there may be other rows in other strata of the hill.

Tomb No. 13 is supposed to be the oldest, and tomb No. 4 the newest. Most of the smaller tombs are without pictures or hieroglyphics. Tomb No. 2 has an inscription of the date of the 43d year of Usertesan I., who was the first king of the 12th dynasty, and reigned, according to Mariette, 3604 years before Christ. Tomb No. 3 bears the date of the 6th year of his successor, Usertesan II. These tombs take us back a thousand years before the accepted date of Noah and his ark, to the days of Mahabaled, Jared and Enoch.

The pictures and inscriptions in all the tombs are so very much alike that it is hardly necessary to examine more than two or three of the tombs, unless you be an archæologist in quest of discoveries.

Tomb No. 2 is one of the most attractive. It is one of the largest. It has a fixed date, and its pictures and inscriptions are in a fair state of preservation. No. 2 is the tomb of Aménemhat, whose name was so long and so hard to pronounce, even by contemporary Egyptians, that it was frequently shortened to Ameni. According to the inscriptions, he was every sort of a thing. In the first place, he was governor of that province of Egypt which was called the Oryx nome, and in which these tombs are located. Egypt was divided into nomes, or provinces, of which the names and the boundaries varied. Oryx means a wild goat. In addition to being the governor of the province, Ameni was, as the hieroglyphics are translated, a double prince, treasurer of the king of lower Egypt, true royal acquaintance of the king, regulator of thrones, overseer of horns, hoofs, feathers and minerals; superintendent of all things which heaven gives and earth produces; chief

captain of the hosts, priest of Shu, Tefnut, Horus and Anubis; set over the mysteries of divine words; master of all the tunics, etc., etc., etc., etc. In fact, according to Ameni's account of himself, there could hardly have been space, occupation, dignity or power left in Egypt for any other functionary. But all inscriptions in all tombs are equally laudatory, self-complaisant and comprehensive.

Ameni's tomb may be said to be divided into three parts: The main hall, which is about forty feet square; the small sanctuary back of it, and the portico in front of it. In front of the portico there was originally a closed space. This has almost entirely disappeared. There are a few stones left, which appear as if they may have formed parts of walls. The portico was supported by two fluted columns. The roof of the main hall was supported by four. In this tomb there are two shafts. In some of the tombs there are as many as six. In tomb No. 28 there are eight. In the sanctuary is the mutilated statue of Ameni, seated on a throne, and flanked by two small statues: the one on his right, of his wife; the one on his left, of his mother. The sanctuary answers to the sirdab of the mastába. The ceiling of the portico was arched transversely, while the ceiling of the main chamber was divided into three longitudinal arches. So the Egyptians of this remote period must have had some knowledge of the arch.

When you enter you find yourself face to face with one of the great and still unsolved questions of Egyptology. What difference is there between the fluted columns of this temple and the Doric columns of early Greek architecture? Is there any generic difference? But these columns must have preceded Doric columns by at least ten and, quite probably, twenty centuries. Then these columns must have been seen and imitated by the Greek; and the Greeks, therefore, are not the inventors of Doric architecture. But could the Greeks have seen these columns? There's the question in a nutshell. The writing on the subject is voluminous. Spare yourself the trouble of reading by accepting the sensible conclusion that it makes little difference whether a nation import or invent elements of art if it alone knows how to combine them into creations of life and beauty. One of these columns is no more suggestive of the Parthenon than a boulder of the glacial period is suggestive of the Pyramids.

Of the statues in the shrine very little is left. Another interesting question suggested is, how far was portraiture understood and permitted in Egypt. Very few Egyptian statues have strictly human countenances, but there are differences in noses, lips and

eyes, though none of the noses, lips and eyes may be exactly true. You learn to distinguish a statue of Ramses the Great from a statue of the Usertesan, or the Thothmes, family.

In some statues portraiture is undoubtedly attempted and approached, but there are so few instances of success that success seems an accident.

The tomb of Chnemhotep, which is immediately next to the tomb of Ameni, is quite as large and as interesting. Chnemhotep was as great a man under Usertesan II., as Ameni had been under Usertesan I. He was everything Ameni had been, even to being master of all the tunics. There are more hieroglyphic inscriptions in this tomb than in the other. In one of the inscriptions is this interesting statement: "My first honor was in establishing for myself a tomb chapel; for as the saying goes, a man should imitate the acts of his father. Now my father made for himself a ka-house in good stone, that he might plant his name in eternity; that he might make it firm forever, forever living in the mouths of generations, forever established in the mouths of the living." This seems to prove beyond all doubt that tombs were erected by the living, and not by their descendants, and that they were monuments of vanity and not of filial piety.

The chief interest of one picture in Chnemhotep's tomb arises from the fact that the persons represented are certainly not Egyptians. Egyptians did not have beards and did not wear variegated garments. Then who are they? That is another of the unanswered questions of Egyptology. The inscriptions about them state that they come from Abesha, that they are Aamus, and that they are bringing tribute of mesdemt. Mesdemt is supposed to be a precious paint which was used by the Egyptians for coloring their eyes. Where Abesha was, what the Aamus were, and what mesdemt actually is, await solution. Some pious parties are disposed to think that the Aamus were Jews, and that this sketch may represent Abraham's first visit to Egypt. Some of the noses are somewhat Jewish and the general aspect of the whole party is decidedly Semitic. The scene is, moreover, interesting as showing very early effort to depict a figure in profile. In the last figure to the left on the lower row, the artist still felt that he must show both shoulders; so he advances the left shoulder, which otherwise would be hidden by the right one. The same effort is seen in the figure in front of this one and in the second figure from the right in the upper row. The young ladies with their fine gowns and their diadems are still in the old style, that is, their feet and faces, with

the exception of the eye, are in profile, but their bodies are to the front.

The whole scene is discussed by Flinders Petrie in the first volume of his History of Egypt. The scene specially interests Petrie because it displays a civilization which is not Egyptian civilization, but is at least its equal.

Tomb No. 15 is one of the largest and one of the earliest, going back to the 11th dynasty. Baqt or Bakt, the occupant, was also one of the governors of the Oryx nome, and possessed of all possible dignities, honors and titles. On the north wall of the main chamber, the third row from the top, are women weavers, and then women acrobats, ball players, etc. Here are given two instants of the same jump, for the purpose of conveying a lively impression of jumping. There does not seem to be anything new in the world. Egypt must have had its Edison, and this, probably, was his first idea of the kinetograph.

Many of these figures are repeated so exactly on one of the walls of tomb 17 that the idea is again presented that the Egyptians were acquainted with some mechanical method of repeating figures by printing or by stencil plates.

One of the remaining columns in the main chamber of tomb 17 is another piece of evidence in the vexed question as to whether these caves did or did not suggest to the Egyptians their notions of building. Did the cave precede the temple and determine its architecture, or did the temple precede the cave? The argument is, that there is nothing in cave architecture to suggest this particular style of column, and as this particular style of column does exist in both religious and domestic architecture, these architectures must antedate the tombs. The answer to the argument is, that originally the support may have been a rough pier, such as are left in coal mines nowadays, and that the pier at a far later date was carved into the column.

The column itself is the well-known lotus column, of which the design is supposed to have been suggested by tying together four lotus buds just where they are connected to their long stems. That ornamental capitals were suggested by tying flowers about the tops of plain supporting posts is clearly shown from early Egyptian reliefs.

Attention should be called to the important monumental slab, discovered lately by Mr. Flinders Petrie amid the ruins of Thebes, which is still exciting the curiosity of the public and the controversy of learned Egyptologists. The slab is a magnificent cut piece of black

syenite; ten feet high, five feet wide and quite a foot thick, originally polished like glass. It was quarried, polished, inscribed and erected by Amenhotep III., of the XVIII. dynasty, about fifteen hundred years before Christ. The inscription was partially effaced by Amenhotep IV., who was a heretic, and wished to destroy all evidences of the orthodox religion. Seti I., the founder of the XIX. dynasty, and who was thoroughly orthodox, restored the inscription and re-erected the slab. Finally, Maremptah, the last king of the XIX. dynasty, who was rapacious and selfish, and who is supposed by some scholars to be the Pharaoh of the Exodus, made use of the slab for his own purposes. He built it into the walls of his palace, face in, and covered the back with a long inscription to his own honor and glory. In this inscription, for the first time in the history of modern Egyptian exploration, is found the word "Israel." It occurs in a sentence near the end of the inscription, which has been translated in several different ways.

The difficulties seem to be in the meaning of the signs which have been translated *Israel is without fruit*, and also in the signs translated *widow.*

At the meeting of the Oriental Congress, held in Paris last September, Naville, who is as near the top of Egyptology as any one, advanced the idea that the inscription was carved after the Exodus, when the Egyptians supposed that the Israelites had forever disappeared, swallowed up by the sands of the Arabian desert.

That so far no other allusion to Israel has been found in Egypt is a disappointment to Bible scholars. But they should consider that the thorough exploration of Egypt has only commenced, and that any day a discovery may be made which will bring full satisfaction to the strictest orthodoxy.

# THE PHYSICAL GEOGRAPHY OF NEW YORK STATE.

RALPH S. TARR.

## PART III.—PLAINS AND PLATEAUX.


FIG. 1.—DIAGRAM TO SHOW THE TYPE CONDITIONS OF PLAIN AND PLATEAU. BASAL LINE SEA LEVEL. CRESTS OF HILLS IN PLATEAU CAPPED BY HARD STRATUM.

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DESTRUCTIONAL PLAINS.

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River-cut Plains.
Ice-scoured Plains.
Plains of Denudation.
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DEFINITION.—A plain is a level tract of country, and it is customary to limit the term to level tracts not high above the sea, while those that are elevated are called plateaux. Naturally this distinction has little if any meaning, even in common usage, for there are many so-called plateaux, such as that on the western side of the Appalachians, which are less elevated than the "plains" of the West. Therefore I do not consider it worth while to attempt to maintain the distinction in this article. Plains and plateaux are of the same genus, the difference arising chiefly out of the difference in elevation and the results which this makes possible.

LIFE HISTORY.*—Both plains and plateaux, in their typical development, are notably level areas; but a plain that for any reason begins as a level tract, will, if opportunity offers, become irregular. Upon its surface water will flow; and this, if high enough above sea level, will of necessity cut channels. Hence the plain will begin to be dissected, and if a plateau high above sea level, it may be so deeply carved that, like the Catskills,† it becomes so mountainous that people class it among mountains. Therefore in the development of a plain

* Davis, Proc. Am. Assoc. Adv. Sci., 1884, XXXIII., 428–32.
† Tarr, Bull. Am. Geog. Soc., 1897, XXIX., 36.

from an original fairly level condition, greater and greater irregularity is introduced, until the plain becomes a hilly, or, so far as differences in level go, even a mountainous country.

At first * the streams cut steep-sided valleys, to shallow depths if the plain is low, but as great cañons if on a high plateau. This is because the streams cut rapidly along their channels and carve valleys only slightly wider than themselves. But the weather is at work all the time, and this broadens the valleys, making them less angular. Yet as long as the stream can cut into its bed, *its* action is more marked than that of weathering, and although the valley broadens, it still remains a gorge or cañon. In time, however, the stream cuts so low that further deepening is either greatly checked or wholly stopped. Then the sole action of weathering broadens the valley, and this carving of the plain, in the end, produces broadly sloping valleys and gently rounded hills. This stage is reached much more quickly in a moist than in a dry climate, because the agents of weathering are less active in the latter than in the former. This is one of the reasons why the plateaux of the arid West are crossed by rugged and narrow cañons, while that near the base of the Appalachians is carved into rounded hills and valleys.

Beyond this stage the development is slow; but since the streams can cut no deeper, while weathering is constantly reducing the surface, there is no other end than the ultimate reduction of the surface to a level condition, provided the land stands quietly and nothing occurs


FIG. 2.—TO ILLUSTRATE IDEAL DEVELOPMENT OF PLAIN IN ROCKS OF UNIFORM TEXTURE, STARTING WITH UNDULATING SURFACE IN A; TRENCHED BY STEEP SIDED VALLEYS IN B; THESE BROADENED OUT IN C TO THE CONDITION OF MATURITY; AND FINALLY, IN D, A GENTLY UNDULATING PLAIN DEVELOPED THROUGH DENUDATION, BUT THIS TIME NEAR SEA-LEVEL.

* Davis, Proc. Am. Assoc. Adv. Sci., 1884, XXXIII., 428–32.

excepting this normal work of water and weather. The plain, at first roughened by these causes, then, after a certain stage is reached, becomes more and more smooth, until in the end it would actually become a plain again, as at the start, though this time with the surface near the sea. It happens that the land *is* in movement, and that other things may occur to interrupt this development, so that the full cycle is rarely, if ever, completed. Of *young plains* (A and B—Fig. 2), that is, those newly formed, there are many; of *mature plains* (C—Fig. 2), that is, those considerably dissected, there are also great numbers; but of *old plains* (D—Fig. 2), those that have passed into a second childhood, we have none of any size that can be proved to be of this origin. The RATE of development from youth to old age, as well as the intensity and variety of surface form produced, will vary greatly with the elevation above the sea, the kind of rock, whether hard or soft, the slope of the surface, etc.

CLASSIFICATION OF PLAINS.*—There are two great classes of plains, those that have resulted from *destruction* of land and those that have been built up, or *constructed.* The former may be called *destructional*, the latter *constructional.* Both classes may be made by several causes, such as the action of the sea, of lakes, of rivers and of glaciers. Plains produced by these causes may be called Marine, Lacustrine, Fluviatile, and Glacial. When a glacier is ending on the land, its melting furnishes both water and sediment in amounts quite different from that which would come under more normal conditions. The action of this ice-furnished water may also build plains, as well as carve them, and these may be called Glacio-fluviatile plains. Volcanic action, by outpouring lava or volcanic ash, may build Volcanic plains. During the general wearing down of the surface, by the action of *denudation*, plains may be formed by the important agents of destruction included in this term. Plains originating from EITHER one of these causes may be newly formed, and hence young, or they may become mature, or, theoretically, any one may have passed to the stage of old age. These facts are graphically stated in the following table, to which are added the names of some of the chief subdivisions of these several classes:

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*See also Davis, Proc. Am. Assoc. Adv. Sci., XXXIII., 1884, 428–32; Powell, Nat. Geog. Monog., Vol. I., 1896, 34.

CLASSIFICATION OF PLAINS.

| | CONSTRUCTIONAL. | DESTRUCTIONAL. | |
|---|---|---|---|
| Marine. | Salt marshes. Deltas.<br>Filled bays.<br>Raised sea-bottoms. | Wave cut plains. | Any of these may be young, mature or old. |
| Lacustrine. | Fresh water marshes. Deltas.<br>Filled lakes.<br>Lake bottom plains. | Wave cut plains. | |
| Fluviatile. | Floodplains.<br>Terraces. | River cut plains.<br>Terraces. | |
| Glacial. | Till plains. | Ice-scoured plains. | |
| Glacio-Fluviatile. | Gravel-filled valleys.<br>Overwash plains.<br>Terraces.<br>Deltas.<br>Sandplains. | Same as Fluviatile. | |
| Volcanic. | Lava flows.<br>Ash fields. | None. | |
| Plains of Denudation. | All of the above excepting volcanic. | Plains in horizontal rocks.<br>Peneplains. | |

## Constructional Plains.

Marine Plains.—Along a very large part of the sea-coast line of New York, *salt marshes* are in process of construction, and one finds every gradation, from a bay to an extensive marsh. This coast line, which is mostly that of Long Island, is very irregular, and the indentations have chiefly resulted from a recent sinking of the land, which has allowed the water to enter the valleys. Hence the Hudson, and many of the streams of Long Island, enter the sea, not over deltas, but at the head of bays and fjords. These partly protected indentations do not receive the full force of the ocean waves, and hence the sediment that is dragged down from the land by rain-wash and by rivers, is not removed by sea action, but accumulates on the bed of the bays, tending to fill them. An even more important reason for this protected condition over a large part of the coast, particularly along the shores of Long Island, is the construction of bars of sand by wave and wind action. Hence the greater portion of the south shore of this island is largely shut in by sand bars, or beaches, at some distance from the true land margin, or the *old land.* The *new coast* is therefore straighter than the old, and the space between the old and new land is occupied by protected bays

and sounds. From here southwards to the Rio Grande, excepting at the southern end of the Florida peninsula and the delta of the Mississippi, these same conditions exist.

*Delta Plains.*—Where streams enter these bays they deposit their sediment very nearly at the place where the current is checked upon entering the quiet water. The continual dumping of

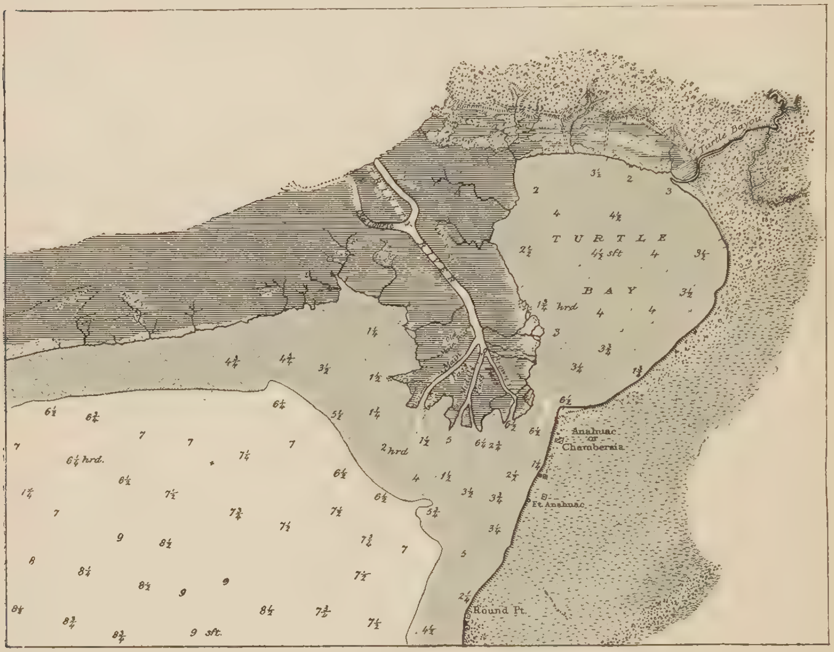


FIG. 3.—MAP OF A DELTA AT THE HEAD OF GALVESTON BAY, TEXAS, WHERE THE TRINITY RIVER ENTERS. NOTE THE SHALLOWNESS OF THE WATER NEAR THE DELTA AND IN TURTLE BAY (FROM U. S. COAST SURVEY CHART 204).

material here will, in time, build *marine delta plains.* Layer upon layer is deposited, and the delta grows outward into the bay, with a level upper surface and a steep front under the water, upon the face of which sheets of sediment accumulate at a steep angle (Fig. 4). Thus, built as a plain, which is a part of the sea shore, it cannot grow far above sea-level. Hence, this action makes it a nearly dead-level plain, and when the stream that is building it, and that extends out over it, is in flood, the nearly horizontal channel cannot contain ALL the water that is supplied. Therefore the water overflows the delta and deposits upon its surface a horizontal layer of sediment, so that the plain is actually built a slight distance above sea-level, as is the case in the delta of the Mississippi. Being gen-

erally enclosed between hill slopes, sediment is washed from the sides; and hence, under such conditions, the delta is a plain sloping from the valley-sides toward the middle, and from its head to its

FIG. 4.—IDEAL SECTION OF A DELTA, AFTER GILBERT. SEA-LEVEL THE HORIZONTAL LINE ON RIGHT.

margin, which is really some distance under water, where it terminates in a terrace front that is constantly being extended seaward.

Such a delta plain is very level, but yet is marked by some depressions and elevations. Places, especially those near the stream channel, where more deposit is made, rise above this level, and the river may enter the sea through two or more mouths, or *distributaries* (Fig. 3). Now and then it abandons one of these, or changes its course, thus leaving the old channel and carving a new one. Then the abandoned channel becomes a *bayou*, and later, cut off from the sea and river by the deposit of sediment, may become a lake. But these are all minor irregularities in a plain of remarkably uniform general level.

*Filled Bays.*—The sediment brought by the rain and the small streams, as well as that coming from the large rivers, together with some of wave origin, drifted about by tidal currents, is strewn over the bed of the bay. This is deposited quite irregularly, according to the rate of supply and the velocity of the current, which varies from place to place. If this filling continues long enough, the effect would be to transform the bay to a level plain (a *filled bay*), whose elevation was approximately that of the sea-level, at which level further deposit would be greatly checked and finally stopped.

*Salt Marsh Plains.*—This work of bay-filling is greatly aided by the action of marine plants.* When any portion has risen nearly to the low-tide mark, eel grass commences to grow, and this, by checking the velocity of the tidal current, adds to the shallowness, which is still further increased by the death of the eel grass itself, as well as by that of the animals which it supports. This continues about to the low-tide level, where the eel grass ceases to be able to thrive. Above this there is a barren zone up to the level of the midtide,

* Shaler, Sixth Ann. Rept. U. S. Geol. Survey, 1885, pp. 353–398.

where other plants, the salt marsh grasses, commence to thrive, with the same result. They can grow upon a salt swamp up to the level of the highest tide, and as a result, by their aid, extensive


FIG. 5.—A NEARLY FILLED BAY JUST SOUTH OF BROOKLYN ALMOST ENCLOSED BEHIND A BAR CALLED ROCKAWAY BEACH. VERY NOTABLE DEVELOPMENT OF SALT MARSH, REPRESENTED BY THE DOTTED SHADING (FROM BROOKLYN SHEET, U. S. GEOL. SURVEY).

plains are being built in the enclosed bays; and in some places these stretch as salt marshes from the ocean beach or bar to the margin of the old land (Fig. 6). They are remarkably level marine swamps, with minor irregularities, which are covered at very high tide, but exposed to the air for most of the time. Through them extend many river-like, tidal channels, through which the rising and falling tide passes. In time even these are filled, and gradually the plain is raised above the level of the highest water, and the salt marsh then becomes dry land.

These salt marsh plains have considerable economic importance. There are scores of thousands of acres along the sea coast, not far

from the large cities, which need only the exclusion of the tide to transform them to arable land. Already this has in some cases been done by artificial diking, and in the Evangeline County of

FIG. 6.—SALT MARSH PLAIN AT IPSWICH, MASS. WOODED GLACIAL HILLS RISE ABOVE THE PLAIN, AND THE OCEAN SAND BAR, BEHIND WHICH IT HAS BEEN FORMED, IS SEEN IN THE WHITE HILLS IN THE BACKGROUND (PHOTOGRAPH BY J. L. GARDNER, 2d).

Nova Scotia, near Cape Blomidon on the Bay of Fundy, on the coast of England, and particularly in Holland,* very extensive salt marsh plains have been reclaimed from the sea. In time, however, nature herself will reclaim them.

Not far from the City of Brooklyn, and along the coast of New Jersey, just south of New York City, there are extensive salt marshes,† and all along the Long Island shore, as well as that of Connecticut to the north of this, there are patches of this marshy land.‡ Sometimes these grade almost imperceptibly into dry land; and habitable plains end, without any sharp line of demarkation, in a salt marsh. Being nearly at sea-level, the marine plains so far described, unless elevated, can pass through no complex stages of development, but will remain level tracts of land near sea-level, and crossed by streams flowing in almost imperceptible valleys.

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* Smock, Ann. Rept. New Jersey Geol. Survey, 1892; 313–353.

† Vermeule, Ann. Rept. New Jersey Geol. Survey, 1896; 287–317.

Cook, Geol. Survey, New Jersey. Report on Cape May County, 1857, pp. 15–65, 91–94; Ann. Rept., 1869, pp. 23–41; Geology of New Jersey, 1868, pp. 300–308; Annual Report, 1885, pp. 61–70.

‡ Mather, Geol. of New York, First Dist., 1843, pp. 17–19; p. 234.

*Raised Sea Bottoms.*—Further to sea, beyond the new land, the tidal currents and waves are distributing sediment over the bottom, building a plain on the ocean bed. For a distance of 75 or 100 miles from the New York and New England coasts there is such a plain of remarkable levelness, made of layers of sediment which have obscured many of the irregularities that may have once existed. If the land along this part of the continent should rise to an elevation 600 feet above the present, there would be a coastal plain sloping gradually from the present shore line to the new sea shore. Such an elevated *sea bottom plain* would be a constructional plain built by deposit and raised into the air by the forces of elevation.

This case finds no actual present illustration within this State; but just south of it, in New Jersey, and from there to the Rio Grande, the lowlands bordering the coast are actually of this origin. The plain of the Pine Lands of New Jersey (Fig. 7) and the coastal plains* of the Southern and Gulf States, represent an old sea bottom slightly elevated above the ocean. That of Texas has been so recently elevated that fossils of animals now living in the Gulf are enclosed in the clays; and it is so young, and the slope so moderate, that it is a great, swampy tract, with streams flowing almost without valleys.

FIG. 7.—IN THE PINE-LANDS OF NEW JERSEY. RAISED SEA-BOTTOM PLAIN (DAVIS SERIES OF GEOGRAPHICAL LANTERN SLIDES).

While at present New York has no such plains as these, we are able to look back in time to a period when there were such level tracts stretching westward from the old land which existed among the ancient Adirondacks and New England mountains (see Part II of this series). Near the close of the Paleozoic, when the Appalachians were uplifted, these *coastal plains* were elevated above the great interior sea, and they were very extensive, including the greater part of New York. It was upon this plain that the vegetation grew out of which the coal beds of Pennsylvania have been

* McGee, Twelfth Ann. Rept., U. S. Geol. Survey, 1891, pp. 347–521.

made; and it is not improbable that similar tree-covered swamps at the same time existed in New York, although now all traces have been removed by denudation. The history of this ancient plain, since that time of first uplift, has been so complex, and the record of it so battered by the attacks of the agents of destruction, that it is only by a careful study of the geology of the region that we are able to state these facts. The low plains have been raised to plateaux and greatly dissected and transformed (Fig. 17); but in the beginning they were true sea-bottom plains.

LACUSTRINE PLAINS.—*Lake-Bottom Plains.*—In lakes very nearly the same kinds of plains are made as those of the sea, and this State furnishes many illustrations of the several kinds. During the closing stages of the glacial period there was an ice dam across many of the streams; and temporary lakes existed where now there is dry land.* Most of these were small, and the deposits in them have built either small plains, or else have not been extensive enough to smooth over the lake bed. Such plains may be looked for in many of the valleys of the north-flowing streams, most of which were held back by the ice dam. However, in the case of the Great Lakes,† while the outlet through the St. Lawrence was clogged by ice, the level of the waters was raised so that at one time the outflow was past Chicago, and at another past Fort Wayne, Ind., and still later through the Mohawk in New York. The last stage existed for a long time and extensive beaches were built. Beaches made during these high-water levels were constructed along the shores of both Erie and Ontario. These extend as ridges or narrow plains, which are really terraces, remarkably level and continuous.

During this stand of the water, deltas were constructed which now exist as broad, level-topped areas of gravel. Over the bed of the lake, sand and clay were strewn, filling some of the depressions, so that the surface, already quite level, was made into a more typical plain. Therefore, south of the beach-terraces and ridges now forming on the present lake shore, there are plains which were once lake bottom, and which owe some of their levelness to this fact.

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* For the Red River plains of Dakota and Canada, see Thomas, Hayden Geol. Survey, Sixth Report, 1872, p. 293; Upham, Monograph, U. S. Geol. Survey, Vol. XXV., 1895. For Bonneville Plain, see Gilbert, Monog., U. S. Geol. Survey, Vol. I., 1890. This lake bottom plain is not of glacial origin.

† The history of the Great Lakes will form a separate part of this series, and then these deposits will be more fully described with bibliographic references.

If Lake Erie should be drained there would be a similar, though much more extensive, plain on the site of the lake.

*Lake Delta Plains.**—In lakes, especially the smaller ones, the water is shallow, the bottom is not sinking, and there is only slight wave action, and no marked tides. Hence in these there is less chance of removal of sediment than in the sea. Rivers bringing their load to the ocean do not succeed in accumulating all of it near their mouths, but much of it is strewn over the sea floor, being carried hither and thither; those entering lakes lose nearly all of their load, and most of it is dropped near their point of entrance. The lake filters the water of its sediment, so that the outflowing stream is pure and clear. Some of this sediment is strewn over the lake bed; but most, and the heaviest, settles near the river mouth, building a delta. Therefore opposite the mouths of most streams entering lakes there are true delta plains, some of which are quite extensive.

In the Finger Lakes these are abundant, and at the head of each of these there is a broad flat which is a true delta. These are not truly level, but extend beneath the lake water at their margin, are swampy near the shore, and rise gradually both from the lake shore and from the central part of the valley toward the margin. This elevation of the surface is due to the deposit of sediment brought by the normal river floods. The town of Ithaca, at the head of Lake Cayuga, is built on such a delta, and mainly on the eastern side of it. The town of Watkins, at the head of Lake Seneca, is on the western side of a similar delta. The position of these towns is due to the fact that the tributary streams from the east are more numerous in the former case, and from the west in the latter. They have elevated the surface of the delta near their mouths, and transformed it to dry land, while the opposite side is swampy. These are true, though very flat, alluvial fans.

*Lake Swamp Plains.*—As in the case of the sea, so in lakes, when the bed has been raised enough, vegetation commences to take root. On the exposed shores of large lakes this is not possible, because the waves keep the mud and sand in such movement that the plants cannot take root; but here, as in the sea, there are bays, and there are also places protected by sand bars, and in these vegetation can grow, as it can also in the smaller lakes in which large waves cannot be generated. The life and death of plants helps to build up the bed, partly by their own addition, partly by the accu-

* Gilbert, Monograph, U. S. Geol. Survey, Vol. I., 1890, pp. 65–70; 153–167.

mulation of remains of animals which thrive in the plant-covered plains, and partly by entangling sediment, and causing it to settle in the quiet water. These often transform the shores of lakes, especially small ones, to swampy plains.

*Filled Lake Plains.*—In the end the work above described may completely *replace* the lake by swamp. A very large majority of the peat-bog swamps of New York, such as those which abound in

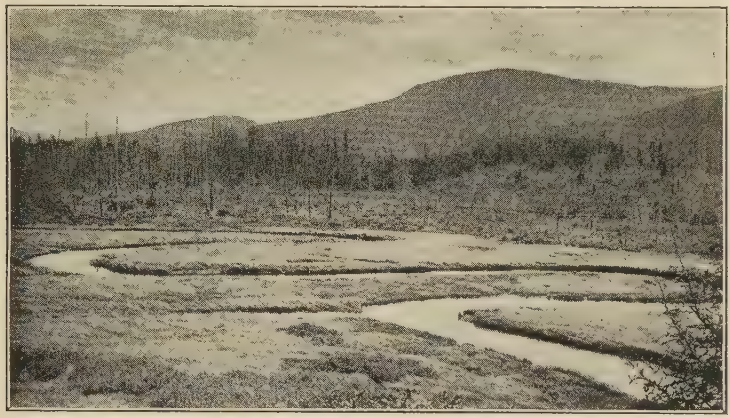

FIG. 8.—STREAM (RAY BROOK) IN THE ADIRONDACKS MEANDERING THROUGH A FILLED LAKE PLAIN (PHOTOGRAPH BY S. R. STODDARD, GLEN'S FALLS, N. Y.).

the Adirondacks,* are the result of this transformation of lake to swampy plain by the filling of the lake, at first by the deposit of sediment, and later by the aid of plants. Many of these bogs have been cut into for one purpose or another, and in them one commonly finds, after passing through several feet of peat, perhaps with thin layers of marl, a bed of clay which represents the first step in filling the old lake or pond. There are thousands of acres of such plains in New York, and some of them are of large size. In Nova Scotia one may frequently see such plains with a diameter of two or three miles.

FLUVIATILE PLAINS.—If, for any reason, a stream flows over a level area with such moderate slope that in time of flood all the water cannot be carried in the channel, when it overflows its banks it spreads out as a sheet of water on either side of the channel. In this lake-like expanse the current is so reduced that some of the sediment is deposited as a sheet, by means of which the irregularities are smoothed over, and a plain formed. This flood-plain is

* Smyth, Am. Geol., 1893, XI., 85–90.

gradually *built* up, and in time may become very extensive, as in the case of some of the great rivers of the world, like the Mississippi.

New York has no such great FLOODPLAINS, though many streams are bordered in part of their course by small ones. This is true, for instance, of streams flowing over deltas, or where they pass across swampy plains that have been built up by lake filling. They also exist where the river course is interrupted by deposits of glacial drift. In parts of the Hudson there are extensive, though narrow floodplains; and in the Susquehanna, Mohawk and Alleghany valleys there are level areas which are true floodplains, and over which the river rises when in high water; but though these are at times of considerable area, they are nowhere of great extent.

These bordering plains may become true *terraces*,—that is, narrow plains bordered toward the river by a steeply descending bank; and often, on the side away from it, by a steeply ascending slope. These are generally due to the cutting action of the river (p. 49), but such terraces are occasionally *built up* by river floods of variable height.* Since none are known in New York it will be sufficient merely to mention this class.

GLACIAL PLAINS.—By these are meant plains constructed by the direct action of the ice itself. When the continental glacier extended across New York, covering the entire area of the State, which was, therefore, transformed into a plain or plateau by the ice covering, all irregularities were submerged and there was a great *ice plateau*, like that now covering Greenland. While this ice existed, moving slowly southwards, it ground the surface somewhat, picked up a load of rock fragments, and dragged these southwards. When these reached the end of the ice, part went away in the streams furnished at the glacier's end by the melting ice, and part accumulated along the margin, forming terminal moraines. There was a constant procession of rock fragments toward this margin, and at any one time the ice held considerable in its grasp, firmly frozen in the bottom layers of the glacier, as we find at present in Greenland. When the ice melted, this *débris*, *till* or *boulder clay* it is called (Fig. 9), was left at the place where it happened to be, so that much of the surface of New York is now covered with a coating of boulder clay, in which clay is the chief element, but scattered through which are numerous boulders of rock not found in any of the neighboring ledges, but dragged from the north; and upon their surface are often seen scratches which they have received on the

* See Tarr, Am. Journ. Sci., XLIV., 1892, 59–61.

journey. This till layer varies in thickness, sometimes barely covering the rock, or even being entirely absent, sometimes reaching a thickness of several hundred feet. In the Western States the

FIG. 9.—SECTION IN TILL OR BOULDER CLAY IN PENNSYLVANIA (LEWIS, REPT. Z, PENN. GEOL. SURVEY).

general till covering is very deep, so thick, in fact, that the preglacial topography has been almost obscured beneath a great thickness of drift. Borings for oil and gas in Ohio and Indiana have revealed buried river valleys beneath the thick till covering of the prairies. Therefore, this part of the extensive plains of the Central States owes its levelness, in large part, to the glacial deposits, and is, therefore, a true till plain.

Most of New York is too hilly for this, but the glacier has greatly reduced the original irregularities, partly by cutting down the hilltops, and partly by carrying off the materials thus derived and depositing them in the valleys. There are hundreds of cases in which stream valleys have been so filled, that, after the ice left, the rivers were not able to occupy them. Some of these are still to be seen as sags in the surface, but others are entirely obscured, though the great majority have merely had their depth decreased by the deposit of drift. By this means the valley bottoms, originally one or two hundred feet deeper than at present, have been filled with till and transformed to valley-bottom plains.

In addition to this, there are narrow, terrace-like till plains, clinging to the hillsides above the valley bottom, apparently representing deposits held *under*, or in the bottom of the ice, when the valleys were filled by the glacier, and allowed to drop down into their present position when the ice support was removed. In the

hilly plateau region, near the divide of the Finger Lakes and Susquehanna, there are many terraces of this origin.

Besides these small plains, there is one extensive level area which owes at least a part of its levelness to this cause of ice filling. This is the plain which borders the Lake Ontario shore (p. 52), and which, except where roughened by irregular glacial deposits, is, in general, remarkably level. The surface of this must have been *somewhat* level before the ice came; but presumably it was crossed by river valleys. Indeed, some of these still show, as in the case of Irondiquoit Bay, which is apparently the pre-glacial course of the Genesee River. Practically all, however, have been obscured by the glacial deposits; and so this, which was apparently a dissected preglacial plain, is now a very regular till-covered plain.

Glacio-Fluviatile Plains.—While the ice front stood at its farthest limit it reached into Pennsylvania, then covering nearly the entire area of New York; but as the glacial period waned, the ice melted, and its front gradually stood along lines farther and farther north. Wherever it remained its melting furnished the streams with great volumes of water and of sediment, thus introducing conditions quite different from those of the present and the earlier past. It may be said that this water and sediment, escaping from the ice front, passed either into streams leading *away from* the ice, or into streams flowing northward which led *toward* the ice front. In the former the water found ready escape; but in the latter it was ponded by the ice dam. In both cases the great volume of sediment-laden water built deposits of interest, some of which are true plains, though usually not of large size.

*Gravel-Filled Valley Plains.**—Where the water found a slope down toward the south, either this was sufficient to allow the great floods to carry all of the sediment, or else it was too slight for this; and in the latter case some of the load had to be deposited. Because so much sediment was supplied, the latter was frequently the case. Even at present, at the margins of the Alpine glaciers, the streams are not able to carry all their sediment load down the steep mountain valleys; and a similar condition is found along the margin of many other glaciers, notably the Malaspina of Alaska (Fig. 10). Hence the streams, depositing some of their sediment, gradually built up their beds, perhaps flowing over the plain in numerous *anastomosing* channels. By this means many valleys of streams flowing southwards from the glacier have had a deep filling of sand and

* Salisbury, Ann. Rept. New Jersey Geol. Survey, 1892, pp. 96–125.

gravel.* One may see this class of plain in many of the tributaries of the Susquehanna and Allegany. They are so numerous that

FIG. 10.—DELTA PLAIN BEING FORMED AT MARGIN OF MALASPINA GLACIER BY DEPOSIT OF GRAVELS BROUGHT BY THE WATER FROM THE GLACIER, BUT NOT CAPABLE OF BEING CARRIED FARTHER (PHOTOGRAPH BY PROF. I. C. RUSSELL).

some form of development of them may be looked for in nearly all of the south flowing streams of New York.

The influence of this kind of deposit is felt even as far as the sea. The floodplain and delta of the Mississippi contain a vast amount of sediment furnished by the melting glacier, and some of the loess of the Mississippi Valley, by which certain prairie areas have been made, had a similar origin. The building of these gravel-filled valley plains, and the prairie areas of fine grained clay, was aided by the fact that when the ice was melting away from the country, the land was lower in the north than now; and hence the south-flowing streams had their grade decreased.

*Overwash Plains.*—Where the surface was moderately regular, but gradually sloping toward the south, many small streams escaping from the ice front combined to build coalescing plains, or flat, alluvial fan deposits, to which the names *overwash plains* or *frontal aprons* have been given. Within the boundary of New York these are typically illustrated on the south side of Long Island,† where there are extensive sandy plains bordering the southern margin of

* Brigham, Bull. Geol. Soc. Am., VIII, 1897, 17–30.

† Lewis, Am. Journ. Sci., XIII, 1877, 235; Upham, Am. Journ. Sci., XVIII, 1879, 81–92, 197–209; Hollick, Trans., New York Acad. Sci., 1894, XIII, 123–130.

the terminal moraine. In the more hilly region of central and western New York there was little chance for these to be formed. Their place is taken by gravel-filled valley plains, though here and there these are broad enough to be classed as frontal aprons. An illustration of this is found just southwest of Cortland, N. Y., and another at Elmira and Horseheads.

*Terrace Plains.**—In many of the stream valleys flowing southwards there are well developed terraces, which are true plains, narrow to be sure, and extending parallel to the streams, sloping southward with them. Nowhere are they better developed than in the Connecticut River valley, where, in some places, there is a series of several well developed terraces, composed of clay, sand and gravel, with level top and steep margin. In origin they are associated with the withdrawal of the ice sheet; but there are two possible explanations, one of which only (constructional) is mentioned at this point. (For the other see p. 49.) This explanation is that the sediment-laden river water was subjected to risings and shrinkings with the change of season. In winter the river was small and occupied a narrow channel. In spring it rose to a higher level and had a broader channel, the present first terrace top; in summer, rising still higher, it filled a still broader and deeper channel, etc. By this explanation each level of the floods occupied a channel of different breadth and depth; and, since *deposits* were being made all of the time, terraces were built, just as a *single* terrace is being made by rivers which occupy a narrow channel at ordinary stages, and a broader one during flood times, when they overflow their floodplains. The floodplain is a true terrace of construction, and accordingly, if this explanation is true, such terraces as those of the Connecticut are merely the floodplains made by floods which rose to different levels in different seasons.

*Deltas.*—Where the glacial streams entered valleys whose natural slope was toward the north, they were transformed into lakes in which their sediment was deposited, as it is in any lake; and since many of these have now entirely disappeared, the deposits that were then made, now appear as part of the land surface. Some of these have made plains like those existing around the shores of the Great Lakes (p. 37). Generally the *beach terraces* are indistinct, though they are very prominent along the ancient shores of Ontario and Erie, and less so about some of the smaller, entirely extinct lakes. Therefore, in many places, as, for instance, along the margin of the

* Tarr, Am. Journ. Sci., XLIV, 1892, pp. 59–61.

Finger Lakes* and Lake Chautauqua, there are gravel terraces, quite level-topped, which border the tributary streams at various elevations above the present lake surface. These streams, flowing down the

FIG. 11.—SMALL DELTA BEING MADE IN A LAKE AT THE MARGIN OF THE GREENLAND ICE SHEET AND SUPPLIED WITH WATER FROM THIS GLACIER.

hillside, entered the lakes during their higher stages, deposited their sediment and built deltas (Fig. 11), as streams are now doing where they enter these lakes at lower levels. They, therefore, stand as witnesses of the former higher water levels.

*Sand Plains.*†—Even more extensive plains of gravel exist here and there in these valleys in positions where it is difficult to account for the source of the gravel. These *sand plains* have the form of true deltas with level tops, furrowed with numerous channels and terminating in a steep front, facing southwards. They were evidently built by the deposits made from a gravel-laden stream, now

* Hall, Geology of New York, 4th Dist., 1843, pp. 342–7; Lincoln, Am. Journ. Sci. XLIV, 1892, 297; New York State Museum Report, Vol. 48, 1895, p. 74; Fairchild, Bull. Geol. Soc. Am., VII, 1896, 423–452.

† Davis, Bull. Geol. Soc. Am., Vol. I, 1890, p. 195; Gulliver, Journ. Geol., Vol. I., 1893, p. 803; Upham, Bull. Geol. Soc. Am., Vol. VIII, 1897, p. 183.

extinct; and careful studies have shown that these streams came from the ice which was forming the dam for lakes now gone, as are the streams themselves. Such plains have not been described from New York, but one is found north of Geneva and another, possibly of this origin, near the town of Brookton, just southeast of Ithaca.

OTHER PLAINS.—During the stay of the ice upon the land, the elevation with reference to the sea-level was lower than now, and the sea entered the Hudson River at a higher level than at present. Then the streams tributary to this river entered a fjord; and being

FIG. 12.—THE MONTEZUMA MARSHES, NORTHERN END OF CAYUGA LAKE (PHOTOGRAPH BY C. S. DOWNES).

loaded with sediment,* they built deltas and terrace deposits in the Hudson itself and its tributaries. Many of these furnish illustrations of these plains, as may be seen near the mouth of the Mohawk and Catskill.†

* Streams then carried more sediment than now, both because the ice was furnishing them with it, and because the land from which the ice had recently disappeared had not yet been protected by vegetation, so that the rain fell upon it with something like the effect that is produced when it falls upon a road, or a ploughed field, in contrast to a pasture or a forest.

† Hale, Am. Journ. Sci., 1821, III, 72–3; Finch, same, 1826, X, 227–229; Mather, Geol. of New York, 1st District, 1843, pp. 129–158; Dwight, Trans. Vassar Bros. Inst., III, 1884–5, 86–97; Davis, Proc. Bost. Soc. Nat. Hist., XXV, 1892, pp. 318–335; Ries, Trans. N. Y. Acad. Sci., 1891, XI, 33; Merrill, Am. Journ. Sci. 1891, XLI, 460–66; Taylor, Am. Geol., 1892, IX, pp. 344.

In the temporary lakes not only was sediment deposited in abundance opposite stream mouths, but some was carried out into the lake and strewn over the floor,* which in some cases was transformed to a plain of gravel, sand or clay (p. 37). Some of these plains are now to be seen in the north-sloping valleys, in which they resemble the gravel-filled valleys of south-flowing streams. In other cases, as in the Montezuma marshes (Fig. 12) at the head of Lake Cayuga, and the Conewango Swamps southeast of Jamestown, in Chautauqua County, there are extensive lake-bottom plains, still in a swampy condition.

VOLCANIC PLAINS.—Since New York is not a volcanic region, there are no illustrations of these plains within its boundaries, and therefore this subject may be quickly passed over. A lava flow, spreading out over a moderate slope, fills irregularities and may build a plain; and so also may volcanic ash erupted and strewn over the country on one side of the cone. Lava plains have certainly existed in the Connecticut Valley, and possibly also in New Jersey; but subsequent changes have entirely destroyed the plains, for the lavas now stand tilted into mountainous elevations.† In the far West many of the plateaux are capped by lava flows of this origin.

## DESTRUCTIONAL PLAINS.

WAVE-CUT PLAINS.‡—The agents of denudation are planing down the surface of the land and carrying materials toward the sea, where extensive plains are being constructed (p. 31); and on their way, stopping in lake or river valley, plains of small extent may be *built;* but in the course of this work of degradation, plains may also be formed by the very *work of destruction*, without the action of building. For instance, the waves, either of lake or sea, may saw into the land, forming wave-cut plains which are generally of small extent and lie beneath the water. Later, these may, perhaps, be raised above the surface.

This horizontal planing of the land by ocean waves is believed by many to have produced grand results in the past, and this has been especially urged by the British geologists. Standing upon the tops of the hills in the Highlands of Scotland and England it is found that they rise to nearly the same level, and it has been suggested that these hilltops are remnants of an ancient *plain of marine denudation*, formed at a time when these islands were at a

* Ries, Trans. N. Y. Acad. Sci., 1893, XII, 107–109.

† See second article of this series, Bull. Am. Geog. Soc., XXIX., 1897, 34.

‡ Gilbert Monograph, U. S. Geol. Survey, Vol. 1, 1890, pp. 35–36.

lower level, during which the waves beat against them for such a long time that the lands were bevelled. Elevation has since raised these plains and streams have cut into them, so that only remnants now remain in the form of hilltops reaching to a nearly uniform level. Since the rocks of the region are of different degrees of hardness, the explanation of the uniform hilltop level must be some condition of lower level than the present; and one possible explanation is this which has been stated. American geologists are inclined to call these remnants *peneplains*, which have resulted from denudation in the air (p. 55).

River-Cut Plains.—As they are cutting their valleys, rivers are caused to meander, and the curve of meander changes gradually, so that in the course of time the river shifts its bed, having its

FIG. 13.—TO ILLUSTRATE TERRACE FORMATION BY LATERAL CUTTING OF A RIVER, WHICH IS ALSO CUTTING INTO ITS BED. THERE IS HERE ONE TERRACE; BUT IF THE STREAM CHANGES ITS POSITION TO THE LEFT, AND THEN CUTS DOWN ALONG ITS BED, A LOWER TERRACE WILL EXIST WHERE THE RIVER BED IS NOW LOCATED (PHOTOGRAPH BY JACKSON, DENVER).

channel now on one side of the valley and now on the other. As it swings it cuts a plain whose width is equal to the change in position. This is known as *planation.**

It is by this action that it is believed that the terraces of destruc-

* Gilbert, Geology of the Henry Mts., Washington, 1880, p. 120.

tive origin are formed. According to this theory, as applied, for instance, to such a river as the Connecticut (p. 44), floods of glacial waters, instead of *building* terraces, gradually *deposit* the sediment in a sheet over the river bottom, building up an extensive gravel plain like those described above (pp. 42–43). After the sediment supply ceased, the stream began to cut a valley in this, for it was no longer *overburdened* with sediment, and its slope was increased by the uplift of the land in the north. Cutting a channel in one place, and then gradually swinging laterally to another point, where it remained to cut another channel, and then changed again, etc., the gravel plain was carved into a series of terraces as the river excavated its channel in the gravel.* Both the constructional and destructional theories apply to these gravel terraces; and since sometimes one and sometimes the other of these causes account for them, a study must be made of each case in order to tell which is the real explanation.

The destructional cause for terraces is the more common, and there are many terraces of this origin in New York, where the rivers have excavated their valleys in the till deposits. As has been stated, many of the mature valleys of New York have been partly clogged with a till filling (p. 41); and since the ice left the streams have been busy carving new valleys, and in the course of their work they have cut terraces. The majority of small streams, as well as some of the larger ones, have such bordering plains extending parallel to them, and descending at the same rate. They can be told from others by the fact that they are made in the boulder clay, which is quite different from the stratified gravel of the gravel-filled valleys.

Ice-Scoured Plains.—This is merely mentioned in order to fill out the classification, though no plain of this nature is known to exist in the State. In passing over the surface of a moderately regular land, the glacier will plane down the hills, leaving the surface more regular as a result of the scouring; and in the course of time, perhaps, the region will be reduced to the condition of a plain by actual ice carving.

Plains of Denudation.—Where rocks are nearly horizontal, as they are throughout a large part of New York, there are sheets or strata of varying hardness, one upon another. Denudation trenches these, and streams carve valleys along their lines of flow, while rain-wash and weathering more slowly wear away the interstream areas.

* Dodge, Proc. Boston Soc. Nat. Hist., Vol. XXVI, 1895, pp. 257–273.

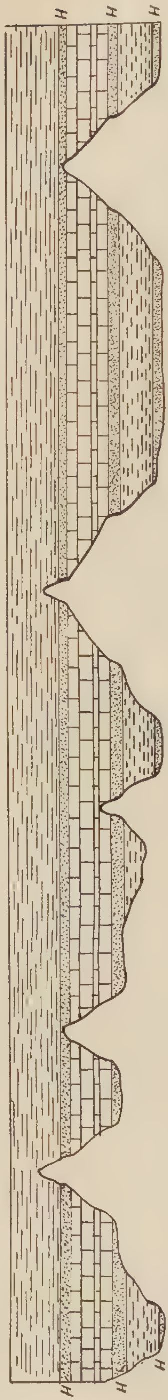


FIG. 14.—STAGE OF YOUTH OR EARLY MATURITY IN A HIGH PLAIN OR PLATEAU WITH STRATA OF VARIABLE HARDNESS (STRATA MARKED H, HARD) AND, TYPICALLY, IN AN ARID CLIMATE. CONTRAST WITH STAGE B OF FIGURE 2.

Such a region, starting perhaps as a plain, is then much dissected, so that, looked at in detail, it has little resemblance to a true plain, but is a very hilly land, especially if its elevation above the sea is great.

However, the fact that the rocks are in horizontal sheets, which are variable in their power of resistance to denudation, will make it necessary that the hill tops shall reach to a nearly uniform level. This is because, when an unusually *hard layer* is reached by the agents of denudation, further cutting is resisted so much more decidedly than in the softer strata, that the further down-cutting is held back at the level occupied by this hard horizontal bed. Hence, even if the original surface reached to different levels, the softer rocks are removed with some ease and the harder ones less easily, so that, while further lowering is slow in the case of those places that are capped by a hard layer, others that are higher, but are capped by softer rocks, will wear down more rapidly, soon reaching the level of the hard layer by which the denudation is being delayed.

In eastern New York there are plains of this origin, though they occupy rather small areas. It is this fact also which accounts for the table-lands and mesas of the plateau region of the West.* These level-topped areas, perhaps deeply dissected by cañons, stand up at a uniform level because of the protection offered by the hard layers (Figs. 16 and 17). The plains of several levels in Texas exist in horizontal rocks †; and the plains and plateaux of central and western New York also owe their present form to this condition.

The plateau of central, southern and western New York is a very hilly country, but the hills reach to a fairly uniform elevation,

* Powell Exploration, Colorado River, 1875, 1–214; Dutton, Monograph U. S. Geol. Survey, Vol. II, 1882.

† Hill, Am. Geol., Vol. V, 1890, 9–29.


FIG. 15.—PHOTOGRAPH OF A MODEL
(MODEL OF I

and many of them are nearly level-topped, so that, standing upon the crests of the higher hills, one looks across to other crests of nearly the same elevation. This is because the Upper Devonian

FIG. 16.—BUTTES ON THE PLAINS OF WESTERN KANSAS, REMNANTS OF A HIGHER LEVEL LEFT STANDING BY DENUDATION (PHOTOGRAPH BY PROF. WILLISTON).

strata are coarse and sandy shales which resist the agents of denudation. In western New York, in Chautauqua County, there are two plains, (1) that IN which Lake Erie is placed, which is faced on the southern side by a steep escarpment,* rising (2) to a hilly plateau region IN which Lake Chautauqua is situated. At present there seems to be no definite reason in the rock structure for this upland plateau and for the escarpment separating it from the lower plain; but in southern Chautauqua County, and across the line, in Pennsylvania, there are remnants of a conglomerate bed, now remaining upon the surface in the form of "rock cities", † where the great blocks, loosened by weathering, and perhaps somewhat disturbed by post-glacial action, now stand in confused, and often fantastic arrangement upon the surface of the land (Fig. 18).

It has seemed to me probable that the western plateau (and perhaps also that of southern-central New York), together with its north-facing escarpment, might have originated as the result of the former protection of this conglomerate stratum, most of which is now removed, the last remnants having been carried away by the ice. To test this I requested Mr. Bonsteel, Assistant in Geology at Cornell, to look about in Chautauqua County for remnants of this conglomerate to the north of the present "rock cities," and he has found fragments *in the till* in the neighborhood of Lake Chautauqua,

* Tarr, Bull. 109, Cornell Univ. Agri. Experiment Station, 1896, p. 92.

† Hall, Geol. of New York, 4th Dist., 1843, 284–285; Carll, Second Geol. Survey, Pennsylvania, Report III, 1880, pp. 57–79; Same, Report IIII, 1883, pp. 195–208.

and has gathered facts concerning the distribution of these fragments elsewhere. Therefore, either the ice has *moved northwards* in this region—not a very probable alternative—or when the glacier came upon this region some remnants of this conglomerate stratum were still left on the surface. If this latter explanation is correct, as seems probable, the plateau character and the escarpment of this section are explained.

At the base of the Lake Erie escarpment, on the northern border of the plateau just described, there is another plain, of which the bottom of Lake Erie forms a part. In New York a narrow portion of this plain extends between the escarpment and the shores of

FIG. 16.—TO ILLUSTRATE THE PROCESS OF DESTRUCTION OF A PLAIN IN WESTERN KANSAS. HILLS CAPPED BY A HARD LAYER, BEING SEPARATED TO FORM BUTTES LIKE THOSE IN FIG. 16 (PHOTOGRAPH BY PROF. WILLISTON).

Lake Erie. Upon this the City of Buffalo is situated; and in this region it is a broad, quite level plain, disappearing gradually under the lake toward the west, and losing its character toward the south as it ascends toward the high plateau of southwestern New York. It extends eastward, gradually losing its typical character as a plain, and toward the north it ends abruptly in the escarpment (Fig. 19) at Lewiston, Lockport, etc. This escarpment is determined by the presence of the hard Niagara limestone, which is also the cause for the Falls; and the plain itself, in its most typical portion, owes its levelness to the presence of this and other hard layers of nearly horizontal rocks.

Below it, at the base of the north-facing Niagara escarpment, is another plain (Fig. 19) which itself is terminated by a north-facing

bluff under the waters of Lake Ontario, the position of this being determined by the presence of the horizontal beds of the very durable Medina sandstone. This is one of the largest and most perfect plains in the State. From Lewiston to Irondiquoit Bay, and from the lake shore to the Niagara escarpment, which loses prominence toward the east, there is a wonderfully level plain crossed by the Rome, Watertown and Ogdensburg railway.

The *general* levelness of this plain is due to the rock structure; but there is a peculiar fact about it, the real explanation of which is not certain. The Niagara and Lake Erie escarpments are trenched by *deep* valleys of pre-glacial origin, the positions of which are now plainly apparent in the topography; and the two plains which these escarpments bound are also dissected; but the Ontario plain is not

FIG. 18.—CONGLOMERATE BOULDER—A PART OF THE "ROCK CITIES."

furrowed by such valleys. In its deepest point the bottom of Lake Ontario is about 738 feet below the lake level, and hence somewhat more than this below the level of the Ontario plain.

There are two prominent theories to account for the basin of Lake Ontario, one that the continental glacier carved it out of the rock, the other that it was a pre-glacial river valley changed to a lake by various causes without marked ice erosion, and chiefly by drift dams left by the ice. If the latter is true, and the bottom of Lake Ontario is an old river valley at approximately the same level which it had before the Glacial Period, the Ontario plain during this time must have been crossed by good-sized valleys of streams entering this ancient and very deep valley. Since they are now invis-

ible, it must be supposed that the glacial drift has obscured the pre-glacial irregularities, and that the plain is therefore only in part due to destructional origin, and in considerable part a plain of construction as the result of drift deposit (p. 42).

The alternative is, that the old surface to the north of the plain, on the site of the present lake, was a pre-glacial valley, whose bottom was not much lower than the present lake level, having since been reduced to the present level by some cause. There are three possible causes for its deepening,—ice erosion, faulting and folding. Of the two latter there is no proof whatsoever; but in favor of the former we have the fact that the *ice* has actually passed over this surface.* No attempt is made here to decide between these two

FIG. 19.—END OF NIAGARA GORGE SHOWING THE NIAGARA ESCARPMENT AND THE NORTHERN END OF THE UPPER PLAIN, WITH THE ONTARIO PLAIN STRETCHING NORTHWARD FROM THE BASE OF THE ESCARPMENT AND CROSSED BY THE NIAGARA RIVER BELOW THE GORGE (PHOTOGRAPH BY J. O. MARTIN).

theories, though it may be said that facts point more strongly toward ice erosion than toward the other explanation. Before a definite conclusion can be reached some detailed field work must be done along the margin of Lake Ontario.

* It is to be noted that the greatest depth of Ontario is on the southern side of its eastern half, and that the glacier, coming against the Adirondack mountain mass, was turned to either side, the western arm going southwest toward this deepest point. Therefore at the place where, according to this theory, the greatest erosion took place, there must have been a decided increase in ice movement due to this concentration of the parts of the glacier which were prevented from going due southward because of the Adirondack obstruction.

*Peneplains.**—Standing on the top of the hills in the Highlands of New Jersey, or of Southern New England, it is found that though the rocks are folded and disturbed, some of the hill tops reach to a nearly uniform level, as they do in parts of Great Britain (p. 47). In England the explanation of this fact has been marine denudation, but in this country it is ascribed to denudation in the air, or subaerial denudation. If the land remained at a nearly uniform level for a long enough time, even the highest mountains would be planed down to nearly sea-level, or to *base-level.* In proof of this is the

FIG. 20.—A VIEW ACROSS THE PENEPLAIN OF NEW ENGLAND (PHOTOGRAPH BY J. RITCHIE, JR.).

fact that New York City is situated in a hilly region which represents the last remnants of a once elevated mountain system, as do the hills of Connecticut, eastern Massachusetts and the Highlands of New Jersey.

It is difficult to account for the uniformity of level of these hills on any other supposition than that at one time they were at a lower level with reference to the sea, having been either bevelled down to a hilly lowland condition or else to the condition of a plain, a *peneplain.*† The reason for this conclusion is as follows: It is known that the country was originally mountainous, because the rocks are very complexly folded; and these contorted strata vary in hardness. Therefore, at first tilted rocks of different kinds were raised to different heights. At present, in

* Davis, Am. Journ. Sci., vol. xxxvii., 1889, p. 430; Davis and Wood, Proc. Boston Soc. Nat. Hist., 1888–1889, vol. xxiv., pp. 365–423; Davis, Bull. Geol. Soc. America, vol. ii., 1891, p. 545; National Geog. Mag., vol. v., 1893, p. 68; Bull. Geol. Soc. America, vol. vii., 1896, p. 377; Nat. Geog. Monograph, vol. i, 1896, p. 269.

† This may have been done by marine denudation or by subaerial denudation. For a critical discussion of this, with numerous references to the literature, see Davis, National Geog. Monog. Vol. I, 1896, p. 269.

many cases, they stand, still at an elevation of 1,000 or 2,000 feet above the sea, but with the hilltops reaching to a rather uniform level, while between them there are valleys of no very great width. In all the time required to lower the surface so far, the result should have been the production of valleys with great width, and hence with mature form, while between them should rise hills of different elevations. To have brought nearly all of the peaks down to a nearly uniform level, the general elevation must have been reduced even lower than now; and the fact that the stream valleys at present are *not* broad or mature, shows that there has been a rather recent uplift.

Therefore the peneplain theory is, that the mountains were bevelled to the condition of a lowland, nearly to that of a plain, during the time when the land elevation had remained quiet for long periods. The surface was then uplifted, the streams began to cut deep valleys, and the old plain to be dissected, so that now only a few remnants remain in the hilltops, which tell of a former plain by the fact that they are of nearly the same elevation. During this time of ancient base-levelling, New York was also subjected to reduction, the Adirondacks and other mountains being lowered, and the New York-Pennsylvania plateau being reduced to a plain standing nearly at sea-level. An elevation ended this period of base-levelling, and again the streams had a steep slope. Since then they have cut their valleys so deeply into the surface of the plain, and weathering has broadened them so much, that the ancient peneplain is nearly destroyed, so that, so far as New York is concerned, there is no evidence left of this former peneplain condition, though the evidence of former reduction is found in the States immediately bordering this one.

I have attempted to state this theory fairly because it is a theoretical possibility. No peneplains of large size at present exist, and there is some reason for doubting if any ever have. This is not the place for a discussion of this subject.

## RECORD OF GEOGRAPHICAL PROGRESS.

### ASIA.

New Rapid in the Yangtze Kiang.—M. Hulot has described before the Paris Geographical Society a new rapid in the upper Yangtze Kiang, in about 109° E. long., formed by the slipping into the river of a vast quantity of rock from its right bank during the torrential rains. The very friable upper rock strata became saturated with water and slipped away from the more solid substratum, the inclined plane upon which they rested. The vast quantity of fallen rock blocked a large part of the channel, so that the width of the river was reduced from 270 to 73 metres. After the subsidence of the river in December, 1896, the rapid that had thus been occasioned was a serious impediment to navigation between the provinces of Yunnan and Szechuen.

The Bay of Kiao-Chau and Shantung.—Dr. Frederick Hirth, in a recent lecture before the German Colonial Society at Munich, spoke of the importance of the Bay of Kiao-Chau, on the south coast of the Shantung peninsula, where the Germans are now in possession. The province of Shantung is the hinterland of the very large harbor the Germans have seized. Though Shantung is one of the most densely populated parts of China, its commerce, industry and agriculture can reach the best development only when the means of communication are improved. The rivers of Shantung are scarcely navigable for small boats. The dikes along the Yellow River, which traverses the province, are very poorly constructed, and its periodical inundations are most calamitous. But even if the river were kept within its banks by adequate dikes, it would not serve as a trading route, and railroads are absolutely necessary for the development of the province. While Kiao-Chau Bay cannot hope for a long time to rival Hong Kong, Dr. Hirth expressed the view that when there is a network of railroads in the province and a rational exploitation of its resources, Kiao-Chau Bay will become an important commercial centre for all the northern part of the Chinese empire.

Sources of the Red River, Tonkin, and Origin of its Floods.—The French possession, Tonkin, has very frequently suffered severely from the floods in the Red River, which begin in May and inundate a wide extent of country. The view has been

held that the floods are due to the melting snows from the mountains of Tibet. M. C. E. Bonin, vice-resident of France, had an opportunity, in the autumn of 1895, to visit the region of the Red River's sources in the environs of Monghoa-ting, to the south of Lake Tali, in Yunnan. He says that the region where the Red River rises is separated by many valleys from the nearest snow mountains of Tibet, the Hsueh-shan, and that, therefore, the melting Tibetan snows do not contribute to swell the Red River floods. Their real cause, he reports, is the monsoon from the south, which carries water vapor from the Gulf of Tonkin to the heights of Yunnan, where the air parts with its moisture. On account of the lack of timber and the slight permeability of the clay soil, the precipitation is poured into the river in quantities too great for the capacity of the stream bed. Hence the destructive floods.—(*Bull. Soc. de Géog.*, Paris.)

## AFRICA.

Lake Rikwa Disappearing.—Rikwa, a lake of considerable extent, which since 1860 has figured upon the maps to the east of the southern end of Lake Tanganyika, has for some years been reported to be drying up, and according to the German explorer Langheld, who visited the lake early last year, the greater part of it has now entirely disappeared, and in its place extends a steppe, over which game throngs by thousands. This steppe, however, is covered by water in the rainy season. The natives told the explorer that the desiccation of the lake was almost wholly accomplished in 1891. There remains of the old lake only about 259 square kilometres in the neighborhood of Ukia and a few marshes in the southeast. Rikwa has thus shared in the general process of desiccation, which has been observed for twenty years among the lakes of Central Africa.—(*Le Mouvement Géographique*, No. 2, 1898.)

The Caverns of Mokana.—*Le Mouvement Géographique* (No. 1, 1898) briefly describes the subterranean galleries in the hills of Mokana, which were recently visited by Lieut. Leon Cerckel, of the Congo State force. These caverns are inhabited by natives, and are in the basin of the Lufira tributary of the Lualaba, source of the Congo. Captain Cameron, in his journey across Urua in 1872, heard of these troglodytes, but did not visit them. Lieut. Cerckel says that the entrances to the caverns were formed by the displacement of rock strata, some of which, resting against one another, form passageways to larger limestone chambers. In these chambers the natives store their provisions and everything

they require. The roofs of the caverns are only three to four metres in height, and the side walls have projections and recesses which make excellent hiding places and are sources of danger to enemies who may enter the caverns. The explorer visited three of these passageways and the chambers to which they led. At the principal opening Chief Mokana has built a little fort to defend the entrance.

## AUSTRALIA.

Mr. Carnegie's Journey through the Great Victoria Desert.—The expedition equipped and commanded by Mr. D. Carnegie, which left Coolgardie, the mining town in south-central West Australia, on July 9, 1896, to travel north-north-east across the Great Victoria Desert to the Kimberley gold fields in the north-east part of the province, returned to Coolgardie in August last after an absence of thirteen months. (*Petermanns Mitteilungen*, No. XII, 1897.) Mr. Carnegie had three white companions, a black boy and eight baggage camels. He made two traverses of the great interior sand wastes, north and south, and a considerable area which had not previously been visited. The chief result of his work is the evidence obtained that an important part of central West Australia affords no prospect of valuable minerals, good grazing lands, or any other utility. Upon the return journey in which the party more nearly approached the eastern border of the province, they met natives who were not only physically of the Jewish type, but also possessed some of the Jewish peculiarities. They entered unknown country in about 27° S. lat., and for many days travelled among sandhills that showed no vegetation except spinifex, acacia and a few other stunted plants. They were compelled to reduce the water ration to a half pint daily for each person, but when only two gallons were left they met natives who conducted them to a remarkable waterhole.

It was a limestone cave and at the opening, three feet in diameter, they found a pole, about twenty feet long, reaching from the opening to the floor of the cave and placed there by the natives to facilitate ingress and exit. The party thus let themselves down into a large chamber from which they crawled on hands and knees through a low passage about twenty-five feet long, at the further end of which was a little stream with an abundance of excellent water. There was good grazing for camels in the neighborhood and the party remained there three days. Mr. Carnegie named this water source, Empress Soak.

On a later occasion they came perilously near suffering very severely for lack of water, but found supplies before they reached extremities. Near Mount Worsnop, in 25° 5′ S. lat., 124° 15′ E. long., they found a lagoon, about a mile in circumference, with fresh water from two to five feet in depth on which wild ducks and other water fowl were swimming. Mr. Carnegie named it Woodhouse Lagoon after Mr. Alexander Woodhouse, the companion of Mr. Carr-Boyd in his earlier explorations. Later, in an area of damp sand which yielded little water, the party spent three days in the difficult work of digging for water in the drift sand, and at a depth of about thirty feet they obtained only ten gallons, to which Mr. Carnegie added ten gallons he collected at another water source.

It was not till the party reached the neighborhood of Sturt Creek, indicated on all good maps, in the north-eastern part of the province, that their troubles from scarcity of water and fodder ceased. The change for the better came about 19° 20′ S. lat., but here they lost two of their camels which ate some poisonous plants. In a land of comparative plenty, the richly watered and grassy region of the Margaret River, Mr. Charles Stansmore, of the party, was accidentally killed by a bullet from his own rifle as he was about to fire at a kangaroo.

Returning from the Kimberley gold fields on the Margaret River, the route of the party was east of their northward track. They were disappointed in their hope to find a practicable route for cattle driving between Kimberley and Coolgardie. The fodder and water problems presented themselves anew and the region between Lake White (21° 15′ S. lat. and 128° 27′ E. long.) and Lake Macdonald (23° 30′ S. lat. and 128° 45′ E. long.) was the most difficult of the entire journey in respect of the fact that it was crossed by many ranges of high and steep sand hills. In a distance of ten miles the party had to surmount eighty-six of these hills.

Death of Explorer Giles.—Ernest Giles, one of the explorers who were the first to reveal the vast unknown interior of the western half of Australia, after the transcontinental telegraph had been completed from Adelaide to Port Darwin, died in November last at Coolgardie, West Australia, aged fifty years. He was an Englishman, who was drawn to Australia by the removal of his family thither while he was still at school in his native land. For years he was engaged in business in Melbourne, or in stock raising, and lack of means long prevented him from carrying out his cherished project of exploring the interior. The late Baron von Müller, who did so much to promote Australian exploration, at last assisted

him to take the field, and he led an expedition which started into the unknown region west of the telegraph line near the Finke River. He was able to advance only about 300 miles from his starting point, but it was the pioneer journey in the exploration of the western interior. The expedition, though Giles's hopes of crossing the interior were defeated, had interesting geographical results, for he discovered the large, swampy area which he named Lake Amadeus, found well watered and grassy mountain ranges west of the headwaters of the Finke, and those conspicuous natural features, Ayers Rock and Mount Olga, now known as the enormous remains of an ancient geological formation.

Meanwhile two other expeditions, led by Col. Warburton and Mr. Grosse and outfitted by Sir Thomas Elder and the government of South Australia, had taken the field, and so Giles returned to his explorations as soon as possible. His west route led him from Ross's Waterhole, on the Alberga, in about 27° S. lat., across the great waste, following a direction a little north of west, and he paused at last far west of the West Australia boundary in about 126° E. long. The country traversed was most inhospitable, the toil and privations were very severe, and Mr. Gibson, one of Giles's party, missed the track and was not heard of again. Giles used horses on both these expeditions, while Warburton and Grosse using camels, proved their superiority in the exploration of Australian deserts.

For his third expedition Giles secured camels from Sir Thomas Elder, and was entrusted with the work of crossing the unknown interior, from east to west on about the twenty-ninth parallel, Warburton and Forest having already crossed the unknown further north. Giles made his real start from Beltana. On this, his most important journey, during which he twice crossed the whole width of the desert, he saw no lands of agricultural value, but merely a wretched succession of scrub, sand hills and spinifex until he reached the settled region of West Australia. Waterholes were found at long intervals, but between Boundary Dam, near the boundary of West Australia and Queen Victoria Spring, a distance of 325 miles, which he was sixteen days in traversing, not a drop of water was found. On his return route Giles struck far north-east for the headwaters of the Ashburton River, and discovered some excellent pastoral country on the way. He determined the east line of the river basin, and then plunged into the desert again, whose undulating surface of sand and spinifex was no more attractive than his southern route had proved to be. His journey ended at the tele-

graph line south of Amadeus Lake, and his fame was established for the almost unequalled extent of unknown country in Australia he had brought to light.

## INVESTIGATIONS OF CORAL REEFS.

CORAL BORING AT FUNAFUTI.—Reference has been made in the BULLETIN to the expedition undertaken by Prof. Sollas, F.R.S., to the coral island of Funafuti, in the Ellice Group, to obtain, if possible, by deep boring, a solid core of rock for study with reference to the controversy as to the origin and mode of growth of coral formation. Darwin's theory accounted for coral forms on the assumption that the foundation on which they rest underwent subsidence while the reef-building coral simultaneously kept adding to the height of its structure, keeping the top within the 100 to 200 feet of the surface of the water which is demanded by the life conditions of the animal. If this theory were true, barrier reefs and atolls would be composed of coral rock masses of great thickness, for they rise from deep water. Dr. John Murray's theory, on the other hand, accounts for the formation of coral islands by considerations of growth and wave action alone, requiring no area of subsidence nor that the coral rock be more than 100 to 200 feet thick. According to this theory, the coral animal began to build upon other marine sediments or upon volcanic rock. The purpose of the boring was to ascertain whether the coral mass is very thick. Prof. Sollas' undertaking failed because quicksands prevented him from penetrating deeper than about 100 feet. The second expedition under Prof. David of the University of Sydney, N.S.W., was more successful. Boring with the diamond drill went on from late in June last till the middle of September and the bore was 690 feet deep before the work stopped. According to the *Geographical Journal* (Jan., 1898), the preliminary examination of the core tends to confirm Darwin's theory as far as this atoll is concerned. Portions of true reef have been found throughout the whole depth, though separated by deposits of coral sand and the remains of other organisms. This investigation would be quite conclusive evidence of the truth of Darwin's theory in certain areas of coral formation, were it not for the possibility that the boring was carried out on a very steep slope of volcanic rock covered by a talus of coral débris that had fallen from a reef on the summit of the rock.

PROFESSOR AGASSIZ ON THE CORAL REEFS OF THE FIJI GROUP.—A letter from Professor Agassiz (*Amer. Jour. of Sci.*, Feb., 1898) gives many details of his investigations last year among the coral reefs of the Fiji Islands. In his equipment was a diamond drill for

boring through reefs, but he did not use it for reasons that will appear. In dredging in Fijian waters, from the surface to a depth of 150 fathoms, an excellent collection of pelagic forms, particularly of crustacea and acalephs, was secured. He had heard of the results of Professor David's boring at the atoll of Funafuti, but concluded from what he saw of the Fiji Islands reef that the Funafuti boring had settled nothing, and that we are still as far as ever from having reached a general and acceptable theory of the formation of coral reefs.

Professor Agassiz went to Fiji under the impression, based upon the writings of Darwin and Dana, that he would find there a characteristic area of subsidence. He was much surprised, therefore, to find within a mile of Suva, a reef about fifty feet thick and 120 feet above sea level, the reef being underlaid by what is probably a kind of stratified volcanic mud. He found numerous evidences of extensive elevation not only on the larger island of Viti Levu, but also on other islands. It was found at Vanua Mbalavu that the northern line of islands were parts of an elevated reef forming vertical bluffs of coral rock which had been raised by the central volcanic mass of the main island to a height of over 500 feet at Ngillangillah, at Avea to 600 feet, at the Savu islands to 230 feet, and on the main island to a height of nearly 600 feet. Much evidence was also collected to show that a great part of the thickness of the elevated reef has been eroded so as to reduce it in some places to the level of the sea, or to leave at other places bluffs or islets.

From this evidence he believes that the corals of to-day have played no part in the shaping of the circular or irregular atolls scattered among the Fiji Islands, and that the recent corals living upon the reefs, either of the atolls or of the barriers, form only a crust of very moderate thickness upon the underlying base which may be either a flat of an eroded, elevated reef or of a similar substructure of volcanic rocks. The Fiji Islands are not situated in an area of subsidence, so that the theory of Dana and Darwin is not applicable to the atolls there, and borings would be futile in that group. Of course there is nothing new in finding coral reefs in an area of elevation, but Professor Agassiz is of the opinion that the evidence now collected emphasizes the fact that there is no general theory of the formation of coral reefs, either barrier or atolls, of universal application. Each district must be examined by itself.

## PHYSICAL GEOGRAPHY.

RELIEF OF THE TERRESTRIAL CRUST.—The well-known German geographer, Dr. H. Wagner, Göttingen, has printed in the *Beiträge*

*zur Geophysik* an interesting paper upon the relief of the terrestrial crust. He divides the crust of the earth into five regions, as follows:

1. The *culminating surface*, occupying 6 per cent. of the land area and comprising the lands whose altitude is over 1,000 metres above the sea: the mean height of this region is 2,000 metres above sea-level.

2. The *continental plateau*, embracing lands whose altitude is comprised between 1,000 and 200 metres; it occupies 28.3 per cent. of the terrestrial surface and has a mean altitude of 250 metres.

3. The *continental slope*, from the altitude of 200 metres above the sea to the depth of 2,300 metres below sea-level, covering 9 per cent. of the crust of the earth, with a mean depth of 1,300 metres below sea-level.

4. The *oceanic plateau*, lying from 2,300 to 5,000 metres below sea-level, and occupying not less than 53.7 per cent. of the crust of the earth with the mean depth of 4,100 metres.

5. Finally, the *most depressed area*, comprising the parts of the earth's crust that are more than 5,000 metres below the sea level. They form 3 per cent. of the crust of the earth and have a mean depth of 6,000 metres below sea-level.

The mean level of the crust of the earth, according to the calculation of Dr. Wagner, is 2,300 metres below the level of the sea. The surface lying above this mean level is 43.3 per cent. of the total surface. The total land surface does not exceed 28.3 per cent., leaving 71.7 per cent. for the water surface of the earth. The mean altitude of the continents is 700 metres. These figures are only approximate, first, on account of the difficulty of calculations of this sort, and, second, on account of our imperfect information concerning the polar regions still unknown, and which represent 4 per cent. of the surface of the globe.

Effect of Mountains on Climate.—In the new edition of his "Handbuch der Klimatologie," Dr. Julius Hann, meteorologist, and the leading authority on climate as affected by mountains, says that every spot along the northern Mediterranean shores, that is famed for the mildness of its winter climate, owes this entirely to its immunity from cold winds which are invariably shut out by a mountain range. Treating of the climatology of the tropics, he shows that data for the interior of tropical Africa are fragmentary, that scarcely any data are yet accessible for the entire tropical

region of Brazil, and very little for the tropical Pacific islands. In the parts of his work dealing with east Siberia and the United States, he shows how the differences in the trend of mountain ranges affect climate. The chain in the west of the Americas lies close to the coast and sweeps west towards Bering Strait, while in Europe, the Norwegian mountain line turns to the east. Accordingly, the influence of the Pacific Ocean is reduced to a minimum in the New continent while the influence of the Atlantic extends far inland in the Old continent. He compares the United States with east Asia, and finds that the States are exposed to the visitation of icy north winds owing to the absence of crossing mountain ranges of any considerable altitude. But in Asia, high mountains and table-lands check the outflow of chilled air from the Siberian centre of cold about the valley of the Lena.—(*Nature.*)

THE CLIMATIC CONTROL OF OCCUPATION.—Mr. R. DeC. Ward, Instructor in Climatology in Harvard University, has a short article on the climatic control of human occupations (*Jour. of School Geog.*, Dec., 1897), with particular reference to Chile. In the trade-wind latitudes, on the western or leeward coast of South America, are the dry and barren regions of Peru and Chile. Between lat. 4° and 30° S., the coast strip is either practically rainless or has a very small rainfall. But south of lat. 30° S., the region of prevailing westerly winds begins and the rainfall increases more and more with increasing latitude until, about lat. 38° S., the zone of heavy rainfall begins.

These great differences in rainfall exercise an important control over human occupation, especially such as are connected with agriculture. In the northern provinces of Chile agriculture on a large scale is impossible, and there is vegetation only in small areas where irrigation is practicable. In the far south, where the abundant rainfall is favorable to forest growth, lumbering plays an important part in the life of the people, and that, with fishing, is the chief occupation. North of the region of very heavy rains, between latitudes 27° and 41° S., there is neither an excess nor a deficiency of rainfall, and agriculture is the chief occupation, though irrigation is necessary in many parts. North of latitude 27° S. the barren nitrate fields replace the green valleys and the vine-clad hills of the middle zone further south, and the nitrate industry and mining are almost the sole occupations of the people. The nitrate ports have to import almost everything in the way of food, including a large number of cattle that come from the agricultural zone, affording an interesting illustration of the control of

climate over imports. Mr. Ward avoids the not uncommon liability to overestimate the influence of one factor at the expense of other causes that determine the nature of occupations. Thus, in Chile, it is the geology of the northern part of that country, combined with past and present climatic conditions, that determines the presence of the immensely valuable nitrate and other deposits. But in this region, human occupation is peculiarly controlled by climatic conditions, for abundant rainfall there would probably destroy the nitrate industry, and farming would become one of the chief industries.

THE HARVARD METEOROLOGICAL STATIONS IN SOUTH AMERICA.—In a letter from Mr. R. DeC. Ward, printed in *Science* (January 21, 1898), he describes at length the meteorological stations established in Western South America, under the auspices of the Harvard College Observatory at Arequipa, Peru. These stations are roughly in a north-south line, extending from the seacoast across both ranges of the Cordillera and down to 3,300 feet above sea-level in a valley at the headwaters of the Amazon River system. The station at Mejia, on the Pacific, nine and a half miles from Mollendo, is fifty-five feet above sea level and 420 feet from the sea, surrounded by desert, and is giving data concerning the conditions of the desert belt when its climate is modified by the proximity of the ocean; the next station is inland, at La Joya, forty miles from the ocean, on a pampa 4,141 feet above sea-level, where desert meteorology, including mirages, dust whirls, etc., are being studied. The central station is at the Observatory at Arequipa, eighty miles from the ocean, and in close proximity to some high mountains, whose meteorological conditions are proving an interesting study. The fourth station is thirty miles northeast of Arequipa, at an elevation of 13,400 feet, amid volcanic sand and ashes, where readings of the wet and dry-bulb thermometers are made whenever a visit to the place is possible. Above this station, on a flank of the Misti, at a height of 15,700 feet, is Mont Blanc station, so called because its altitude and that of the observatory on the summit of Mont Blanc are almost exactly the same. The highest meteorological station in the world is that on the summit of the Misti, 19,200 feet above the sea. The observers have recently been able to visit the instruments on this lofty spot only about once a month, and they usually suffer from mountain sickness when they make the ascent. The seventh station is at Cuzco, in a valley between the east and west ranges of the Cordillera, 11,378 feet above

sea-level; and the last station, at Echarati, is on the east slope of the east range of the Cordillera at the eastern limit of civilized Peru. Thus Harvard has established a fine series of stations in that hitherto meteorologically unknown country, cutting diagonally across the desert belt of Peru, and extending through a region of increasing rainfall, down to the well-watered valley of Urubamba, which belongs to the Amazon watershed. A large number of the observations obtained at these stations are now being tabulated for publication.

The Harvard Geographical Models.—At the meeting of the Geological Society of America, at Montreal, three of the series of these models were described and exhibited, by means of lantern slides, by their designer, Professor W. M. Davis, of Harvard University. They were constructed by Mr. G. C. Curtis, and the purpose they are meant to serve is to illustrate a number of geographical forms in their genetic relationship. The three models exhibited represent a mountainous region descending to the sea; the same area after depression whereby the shore line has become very irregular; and the same area after elevation whereby a coastal plain has been added to the land area.—(*Science*, January 21, 1898)

## GENERAL.

Forestry in Canada.—The Canadian Government has decided to maintain forest reserves in Manitoba and the North West. The heavier timber belts will be withdrawn from settlement and the young trees preserved as the starting point of future forests. In the Turtle and Moose Mountain regions and in some other districts special measures will be taken to protect the reserves from molestation. Last winter Parliament voted a fund to be used to guard timber reserves, as far as possible, against fires.

Professor Guido Cora Leaves Turin.—After sixteen years as Professor of Geography at the Royal University of Turin, Professor Cora has resigned in order to devote himself entirely to scientific research in geography and the related sciences. He has removed to Rome and will hereafter issue his periodical, *Cosmos*, from that city.

Floods of the Mississippi River.—The Department of Agriculture has issued a *Bulletin* by Mr. Park Morrill, in charge of the river and flood service in the Weather Bureau, on "Mississippi River Floods." The *Bulletin* reviews the physical characteristics

of the Mississippi basin and river and briefly covers the entire regimen of the river both in its normal condition and in flood. It is illustrated with charts and tables giving phases of the precipitation and the results of inundation in the most notable flood years. Mr. Morrill writes that in the floods of the past quarter century the western tributaties have not played an important part. The great source of floods is the Ohio basin, with its steep slopes from the crest of the Alleghanies, upon which fall the heaviest rains of spring, at a time when the normal rise of the lower Missippippi brings the river almost to the danger line from Cairo to the Gulf. In the greatest floods the heavy rainfall over the extensive swamp region from the mouth of the Ohio to the Gulf of Mexico is also an important factor. The Upper Mississippi is third in importance as a factor in producing floods. It never discharges a volume sufficient of itself to produce a flood, but rising later than the Ohio, it serves to prolong the high water and thus to increase the overflow.

ROCKALL.—A series of papers on the islet of Rockall has been published by the Royal Irish Academy. Rockall is only about 70 feet high and 300 feet in circumference, a small steep rock, rising on a bank of small extent from the abysmal waters of the North Atlantic, about 260 miles north of Ireland in 57° 36′ N. Lat., 13° 14′ W. Long. The recent revival of interest in Rockall is largely due to Mr. Miller Christy, who has called attention to its eligibility as the site of a meteorological station. The rock has often been mistaken for a ship. The shallow bank on which it stands is about 100 miles in extent from north to south and 50 miles from east to west, with less than 100 fathoms of water over it. It is frequented by fishermen from Grimsby and the Færoes and has high repute as a fishing ground. Investigations made last Summer seem to show that it will hardly be available as a meteorological station on account of the difficulty of surmounting the steep rock.—(*Geog. Jour.*, Jan. 1898.)

## WASHINGTON LETTER.

WASHINGTON, D. C., FEBY. 15, 1898.

WASHINGTON ACADEMY OF SCIENCES.—One of the most important steps toward the promotion of science and the strengthening of the agencies of investigation through unity of organization has been taken in the formation of an Academy of Sciences. There is probably no city in the country in which there is such a large group of investigators as in Washington, owing to the development there of the many bureaux and offices of the Government having to do with lines of original research. The condition of the scientific societies, owing to various causes, has been somewhat anomalous, there being a considerable number of independent organizations, each with its own administrative officers and publications, having little to do with neighboring societies. The lack of unity has been a matter of regret, as it is obvious that due recognition has not been given to the value of the work in the scientific societies from the fact that the results have been greatly diffused through many minor channels.

The origin of this peculiar condition of disintegration has been attributed to the traditions of the first of the organizations, the Philosophical Society. This adopted a somewhat exclusive view of scientific work, being extremely careful in the character of its membership and not attempting to popularize or attract others to its meetings. From time to time it neglected opportunities of forming sections within which topics of special interest might be discussed, and it may be said forced the more active and energetic of its members to seek other channels for reaching the public. As a consequence the Anthropological Society broke away from it, and in turn other organizations have been formed covering various fields of science, as shown by the names, until there now exist seven well recognized scientific associations, known as the Anthropological, Biological, Chemical, Entomological, Geological, Geographic, and Philosophical, besides others of less note. The growth of some of these societies, especially the more popular, the Anthropological and the Geographic, has been rapid, while on the other hand the Philosophical has declined in membership, and has come to be regarded as composed mainly of mathematicians and physicists.

Attempts have been made to bring about such a closer union,

that economy of effort and money might be secured in administration and publication. As a result of the movement a Joint Commission was formed in February, 1888, its functions being advisory. In 1895, believing that fuller coöperation was desirable, this Commission, originally composed of three delegates from each society, was enlarged to include the officers and administrative Boards of all the component organizations. This new Board, consisting of about eighty men, was found to be cumbersome and not wholly efficient; therefore, after considerable discussion, the plan was adopted of forming an entirely new body to be known as the Washington Academy of Sciences, to take the place of the old Joint Commission of the Scientific Societies, and to perform other functions.

The method of procedure has been for the old Joint Commission through a special committee to draw up an act of incorporation and set of by-laws. When these had been agreed upon they were submitted to the component societies and ratified. The problem of choosing the original members of the new institution developed many plans, but out of these one was adopted which proved satisfactory. Each member of the Joint Commission was requested to prepare a ballot of one hundred names; out of these the seventy-five having the highest number of votes were chosen to form the nucleus of the Academy.

The objects of the Academy are: the promotion of science with power to acquire real estate, to hold meetings, publish documents, conduct lectures, assist investigation, maintain a library, and in general transact any business pertinent to an academy of science. The particular function of the Academy has not yet been determined upon, but it is probable that at first its energies will be bent toward the publication of results of original research, or possibly the reprinting of papers of peculiarly meritorious character, or the conducting of the series of Saturday afternoon lectures.

On Wednesday, February 16, the Washington Academy of Sciences was formally organized and the following officers elected: President, J. R. Eastman; Secretary, G. K. Gilbert; Treasurer, Bernard R. Green; Managers, Frank Baker, A. Graham Bell, F. W. Clarke, C. Hart Merriam, H. S. Pritchett, George M. Sternberg, Charles D. Walcott, Lester F. Ward, and Carroll D. Wright.

River Pollution.—The increasing pollution of the waters of the Potomac River is a matter of deep concern to the inhabitants of the city of Washington owing to its marked effect upon the health not only of the citizens but also of visitors to the national capital.

The problems here are similar to those encountered to a greater or less degree in many other cities, according to the geographic environments. In the case of the city of Washington water is obtained directly from Potomac River at a point just above the Great Falls, where the river plunges over a succession of cataracts and finally descends to the tidal estuary extending above Georgetown, or West Washington as it is now called.

The Potomac receives its waters from rainfall upon the Allegheny Mountains, the drainage basin being within portions of the States of Pennsylvania, Maryland, West Virginia and Virginia. The greater part of the tributaries flow in a northeasterly direction through limestone valleys between high, sharp ridges of the harder sandstone. The waters coming from the hills or mountains of sandstone or of crystalline rocks are as a rule clear and pure, excellent for domestic purposes, but when the smaller streams enter the fertile valleys, whose soil is largely the residue left after partial solution of the calcareous, they become discolored and in times of storm the streams carry heavy burdens of mud. Thus the water in Potomac River is often of a yellowish tinge and almost opaque, owing to the load of exceedingly fine clay held in suspension.

In addition to the natural impurities due to washing of the agricultural soils there are, however, more serious causes of apprehension in the artificial pollutions, whose quantity is growing larger each year. In the more northerly parts of the basin, especially in western Maryland, are many coal mines, the water from which is drained or pumped into creeks tributary to the Potomac. This water as a rule contains, besides iron, a considerable quantity of sulphuric acid in various combinations, sufficient in quantity to poison the fish and to be a source of annoyance, if not of injury, to the inhabitants of smaller towns. Many tanneries and pulp mills manufacturing paper discharge their refuse into the flowing waters and sawmills throw the dust out where it may be washed away. It is probable that the acids from the mines neutralize some of the alkalies discharged by the pulp mills, and that mingled in the water new and harmless compounds are formed, many of the deleterious substances being destroyed during the time that the stream is freely exposed to light and air.

With the increase of agriculture in the fertile valleys of the Shenandoah River and the development of manufacturing industries all along the stream, the towns increase in size and new villages spring up. Each of these in time introduces systems of water supply with accompanying sewage, the ordinary form of disposal

being to discharge this into the nearest running water. Passing downstream this is greatly diluted and, in case of refuse from manufacturing establishments, it is often difficult to detect the presence of impurities at points ten miles or more below the place of discharge. Chemical and bacteriological analyses often yield negative results owing to the degree of dilution, but from the fact that pathogenic germs are not often found in water samples it is hardly safe to assume that they may not be present and active. It is well known that these are continually entering the waters of the Potomac River at various points with the sewage and waste materials, and it is hardly probable that in a journey of from one to four days' duration their virulence is entirely destroyed.

The quantity of water carried by the Potomac River above Great Falls in flood ranges from 50,000 cubic feet per second up to 200,000 cubic feet per second, or even more. These floods, of irregular occurrence throughout the first half of the year, are of short duration, the water usually subsiding in a few days to a volume of from 3,000 to 5,000 cubic feet per second. In the months from August to November inclusive the discharge may sink to, or below, a thousand cubic feet per second. At such times there is the greatest need of water, and at the intake of the Washington Aqueduct the quantity may be fróm 6 to 9 per cent. of that in the entire stream.

During the periods of protracted drought the water is clear, since it comes mainly from springs in the limestone regions and is not discolored by mud washed from the fertile fields. To the eye the clear water of summer is preferable to the turbid material borne by spring freshets, but the proportion of invisible organic matter, especially of pathogenic germs, may be relatively great.

The case of Washington may be cited to illustrate the necessity of action being taken by Congress in the matter of protecting the waters of interstate streams. In some portions of the country State lines have been drawn so that drainage basins lie within a single commonwealth, and it is possible for the legislature to enact measures preventing the pollution of rivers from which water is taken for municipal or domestic purposes, but as a rule topographic boundaries have been ignored and State lines have been laid down upon the map, cutting the catchment areas so that streams cross and recross State boundaries. Thus, as in the case of the city of Washington, the source of water-supply may lie in several States. There is here an object lesson before the eyes of our national legislature enforcing the contention that Congress must

for the general welfare of the people provide broad legislation, permitting the protection of the streams which pass from one State into another.

PROGRESS ON THE NEW YORK STATE MAP.—The great map of the State of New York, as planned, will consist of about 250 atlas sheets. Of these, 75 have been engraved and published, and 14 additional are in various stages of progress of drawing and engraving. During the field season of 1897 there have been 10 new sheets surveyed and 4 old sheets revised. These latter were those showing the city of New York. These were prepared about ten years ago and since that time notable changes have taken place in the suburban towns, such as to necessitate a complete revision. The result of this re-survey will be shown in a map of Greater New York—one of the most detailed and important maps yet issued through the coöperation of the State with the National Government.

The list of publications of the Geological Survey gives the names of the sheets now available. In addition to these, the field work on the following has been completed: In the Adirondack region—Newcomb, Thirteenth Lake, Indian Lake, Old Forge and Remsen; in the centre of the State—Utica, Cazenovia, Tully, Skaneateles, Auburn and Moravia; in the southwestern part of the State—Olean and Salamanca; and along Lake Ontario—Hamlin and Brockport. In the completion of the map of Greater New York the Oyster Bay and Hempstead sheets have also been finished. The total expenditure from all sources last year is stated to have been $32,228.

BOUNDARY LINE BETWEEN IDAHO AND MONTANA.—In the Sundry Civil Bill, approved June 4, 1897, an appropriation was made for surveying the boundary line between Idaho and Montana, beginning at the intersection of the 39th meridian west from Washington (or 116° 3′ 0″ 60 west from Greenwich), with the boundary line between the United States and the British possessions, then following this 39th meridian south until it reaches the summit of the Bitter Root Mountains, this line being in all about 70 miles in length. It lies within some of the wildest and least known portions of the United States and crosses a number of large rivers. In locating the position of the 39th meridian a base was taken in the vicinity of the city of Spokane, Washington; from known points here triangulation was continued westward to the summits of the Bitter Root Mountains, and thence in a belt having a general northerly and

southerly position, certain points being determined near the designated meridian.

The field season proved to be less propitious than usual, and great trouble was experienced from the smoke from burning forests. A sufficient number of points, however, were determined so that it will be practicable during the season of 1898 to locate positions for the monuments marking the meridian. Temporary marks are to be established on preliminary or random lines and when the true line has been determined monuments will be erected. The more important of these, particularly near the Northern Pacific Railway, the Great Northern Railway, and the Kootenai River, are to be monoliths 6 feet in length, at least 10 inches square, set 3 feet in the ground and with the words "Idaho" and "Montana" cut on the west and east sides respectively. Similar monuments are to be placed, if possible, at the international boundary and at the summit of the Bitter Root Mountains, while intermediate positions will be shown by wrought-iron posts 6 feet in length and with a brass cap upon which is inscribed a north and south line with the words "Idaho" and "Montana" on the respective sides. Beneath each of these posts are to be buried charcoal or vials filled with ashes. Where the point to be marked falls upon a rock surface holes are to be cut and copper bolts inserted.

Distances along the line are to be measured by chaining, or by stadia, where the slopes are so precipitous that they cannot be crossed. The photographs taken along the course of this boundary exhibit a country of extraordinary roughness and complication of structure. Range after range of tangled mountain masses appear with narrow crests and precipitous sides separated by narrow gash-like valleys. Near the south end of the line is Clarks Fork River flowing to the west into Lake Pend d'Oreille, and to the north of this the Kootenai River which, flowing in a northwesterly direction from Montana, crosses a corner of Idaho and passes north into British territory to form with Clarks Fork the Columbia River.

Survey of the National Forest Reserves.—The forest reserves of the United States are, with the exception of the Black Hills, situated in high mountainous regions, with altitudes ranging from 5,000 to 13,000 feet. They are at a considerable distance from ordinary means of transportation, and the roads or trails leading to or through them are traversed with considerable difficulty. Storms are frequent and during the summer months when snow does not fall the smoke from forest fires often obscures the vision. The surveys of these areas have, therefore, been prosecuted with

great difficulty and with more or less actual privation on the part of the men engaged in the work. In some cases it has been necessary for the surveyors to pack upon their backs their blankets, instruments and supplies, it being impossible to take horses or mules over the route traversed.

The survey of the reserves has been divided into two classes of work, the first being the location of points of control and mapping of the surface of the country in order to prepare maps similar to the ordinary topographic sheets. The second class of work has been the examination of the character of the forests by men specially qualified, and selected for their known ability without regard to political affiliations. These special field assistants obtained information concerning the amount, species, size and distribution of the timber, representing these facts diagrammatically upon the maps. These also show the extent of timber cutting, the damage done by fire, and the location of farming lands. The reports accompanying these maps describe the character of the undergrowth, the soil, the extent and possible value of the mineral lands, the demand for timber and the facilities for taking this out. A discussion is also had of the effect upon the forests of the pasturage of cattle and sheep, particularly of the latter.

The principal areas surveyed during 1897 have been the Black Hills Reserve in South Dakota, the Big Horn and Teton Reserves in Wyoming, the Lewis and Clark and Flathead Reserves in Montana, the Uinta Reserve in Utah, the Bitter Root Reserve, lying partly in Montana and Idaho, the Priest River Reserve in the extreme northern portion of Idaho, and the Washington Reserve in the northern part of the State of Washington. The largest force of men was centred in the Black Hills, there being on December 1 an aggregate of 57 surveyors and assistants in that region. The triangulation of the whole area was completed and about two-thirds has been mapped. During the progress of the work surveys were extended along 1,190 miles of road and 451 miles of spirit level lines were run. The land survey work cost less than $10 per lineal mile, including the expense of instruments and outfits. The entire forest area within the reservation and also portions outside have been examined and the data placed upon the topographic maps.

In contrast to the work in the comparatively well settled Black Hills region has been that carried on in the reservations in northern Idaho and Montana. Here there are few roads or trails and little if any mapping has been done. It was necessary to lay out a scheme of triangulation from the nearest astronomic station, that at Helena,

Mont. The points thus obtained furnish a control from which mapping will be carried on during the season of 1898. Without these maps it has been found impracticable to examine the public forests. The country is an almost unknown region, apparently consisting of complicated ranges of mountains with serrate peaks and separated by narrow, rocky valleys.

In order to make a beginning in the survey of the Bitter Root Forest Reserve it has been necessary to select an astronomic station. The location chosen was in the town of Hamilton, Mont. The latitude was obtained by observations on sixty pairs of stars, and the longitude by time observations and telegraphic exchange of clock signals with Washington University at St. Louis, Mo., on five nights. A permanent meridian mark has been set one-half mile south of the astronomic pier. A base line of 57 miles has also been measured with a 300-foot tape. From this, triangulation was expanded over an area of 6,500 square mlles, furnishing points of control sufficient for a reconnaissance map. A detailed survey has been made of 600 square miles and the remainder of the reserve has been shown by a reconnaissance sketch, sufficient for the purpose of exhibiting the extent of the forest areas and of the portions burned over as well as those naturally bare of timber. The mineral areas and farming lands have also been defined upon this map.

The Washington Forest Reserve in the northern part of the State of that name embraces some of the most attractive mountain areas of the country, both from the ruggedness of the topography and the picturesqueness of the flora. The high snow-clad summits of the Cascade Range send down numerous glaciers which penetrate the dense forests, cutting broad, white lines through the evergreen trees and giving rise to scores of cascades often bounding over cliffs hundreds of feet in height. In the narrow valleys are many lakes, some of them of extreme depth. The best known of these is Lake Chelan, nearly 70 miles in length and from one to four miles in width. The deepest point in this lake is about 200 feet below sea-level, the depth being approximately 1,300 feet. About 400 square miles has been mapped in the vicinity of this lake, a base line for this purpose having been measured near the shore. Level lines were continued from the Columbia River and permanent bench marks established at the head and foot of the lake, the water surface being found to be 1,108 feet above tide. Levels were also continued to the summit at Cascade Pass, the altitude being 5,423 feet.

Observations were made within this reserve by which the extent and variety of the timber areas have been defined and the lands

more valuable for agriculture than for timber have been outlined. On the western side of the Cascade Mountains field work on the survey of the reservation was greatly retarded by alternations of storms and smoke from forest fires. Topographic surveys were extended over about 500 square miles and level lines over the roads and trails. A connection was also made by triangulation with the Ellensburg base on the east side of the mountains.

While various surveys and examinations of many of the public forests have been pushed in the field, attempts have been made by Mr. Henry Gannett to bring together all of the uncollected or unpublished data concerning the lumber resources. Timber cruises have been made by railroads and land companies in areas scattered all through the forested region, giving facts which, when brought together, will for the first time enable the preparation of estimates of the amount, character, and distribution of merchantable timber of the West, and give to the people of the United States a true conception of their property holdings in timber lands. N.

# MAP NOTICES.

BY

HENRY GANNETT.

Since our last notice the U. S. Geological Survey has published nine sheets. Three of these are in New York State, and, as is the case with all the work done in the State, they are upon a scale of 1:62,500, the relief being expressed by contours with an interval of 20′. These three sheets are in the northwest portion of the State and are designated as Medina, Albion and Oak Orchard; the last named being on the south shore of Lake Ontario, the others being respectively south and southwest of it.

One sheet, Apishapa, upon a scale of 1:125,000, and with a contour interval of 25′, represents an area of nearly 1,000 square miles upon the plains of Colorado. The northeastern part of this area consists of typical plains with their undulating surface. The remaining portion, however, is a plateau region, in which the streams have cut heavy cañons, and whose surface is broken with buttes and mesas.

In Idaho is one sheet, Hailey, upon a scale of 1:125,000, with a contour interval of 100′. This represents a portion of the Salmon River Mountains, including the most rugged and highest part of that system. Hyndman Peak, which stands within this area, is, so far as known, the highest peak in Idaho.

In Washington is one sheet, Seattle, upon a scale of 1:125,000, with a contour interval of 50′, which includes the city of that name, with the adjacent shores of Puget Sound, and the glacial hills and valleys upon its eastern shores.

In Oregon is one sheet, Portland, upon a scale of 1:62,500, with a contour interval of 25′. It includes the metropolis of Oregon, with the lower course of Willamette River, and a portion of the Columbia.

In California are two sheets, both upon a scale of 1:62,500. One in the northern part of the State includes Mount Shasta. Indeed, the summit and slopes of this great mountain occupy almost the entire sheet. An examination of this map impresses the reader with the newness of the mountain; indeed, since it was erected stream erosion has made but little impression upon it, and little of its substance has been wasted away. The cañons and

gorges upon its sides are of slight dimensions. The other sheet in California lies east of San Francisco Bay, and is known as Concord. It includes a portion of the coast ranges.

New map of California and Nevada, 1895, published by Whitaker & Ray Co., San Francisco, scale 12 miles to 1″; relief is expressed by crayon shading.

Of the map of Sweden, published by the general staff, upon a scale of 1 : 200,000, two sheets have been issued. Upon these the relief is expressed by a combination of hachures and contours.

That the Government survey of Mexico is progressing is evidenced by the fact that four additional sheets have appeared. These are on a scale of 1 : 100,000, and relief is expressed by contours with an interval of 50 metres.

A relief map of northern Sweden has appeared. It is published upon a scale of 1 : 500,000. Degrees of elevation are shown by a series of tints of yellows and browns.

Of the map of the Netherlands, upon a scale of 1 : 25,000, twenty-five additional sheets have appeared. Upon these, relief is expressed by hachures, and the character of the vegetation and of the crops on cultivated land are expressed by colors.

Among the Dutch maps should be mentioned also the topographical map of Bantam Residency, Java. This map is on a scale of 1 : 100,000, and is composed of nine sheets, published in 1897. Relief is expressed by hachures, and by colors the character of the vegetation, of the soil and of different kinds of crops are represented.

The Geological Survey of England and Wales has published four sheets of an index map. This is, in effect, a general geological map. It is on a scale of four miles to an inch.

Of the geological map of Würtemberg four additional sheets have been issued, upon a scale of 1 : 50,000.

The Geological Survey of Japan has published an agronomic map, upon a scale of 1 : 100,000, showing by colors the character of the soil and of the natural and cultivated products.

Among the geological folios recently issued by the U. S. Geological Survey, is one of an area in southern Colorado, about the City of Pueblo, known as the Pueblo Folio. The maps represent an area of about 1,000 square miles, lying north, south and west of the city.

Besides the maps representing topography, areal geology and economic geology, which are commonly comprised in these folios, there is one representing, by shading, the rock deformations within

the area, the folds and faults, but the feature that particularly distinguishes this folio is a map showing the distribution of artesian water under this area. It represents, by colors and depths of color, the areas in which (*a*) flowing wells can be obtained, (*b*) pumping wells, and (*c*) areas in which artesian water cannot be obtained. Moreover, it shows, by means of a species of contour lines, the probable depth at which, within the artesian areas, water will be obtained.

In an arid region like this, where an artesian well is as valuable as a gold mine, such maps have a direct economic value almost beyond calculation.

## BOOK NOTICES.

*L'Extension du Système Décimal aux mesures du Temps et des Angles. Théorie, Applications Scientifiques et Industrielles par J. de Rey Pailhade, Ingénieur Civil des Mines. Paris, Gauthiers-Villars & Fils, Imprimeurs-Libraires du Bureau des Longitudes, de L'École polytechnique, 55 Quai des Grands-Augustins, 55. Toulouse, Gimet-Pisseau, Libraire-Éditeur, 66, Rue Gambetta, 66. 1897. 8vo.*

M. de Rey-Pailhade works without ceasing at his labour of love, though well aware of the obstacles in his way. "For the time," he says, "the one object must be the adoption of the system for science, so as not to alarm the public, which is the sturdiest supporter of routine."

He has made converts. The Toulouse Chamber of Commerce adopted in April, 1897, a resolution in favour of the application of the decimal system to the division of time and of the circle. His table for simplifying the reduction of minutes and seconds to decimals of the hour has met with favour in Mexico and in Greece. It is true that Mr. Holden, of the Lick Observatory at Mt. Hamilton, does not see the immediate necessity of a change; but curiously enough, says M. Rey-Pailhade, his astronomical assistants, Messrs. Aitken and Schaeberle, make use of the decimal division of the day and the degree.

The conclusion reached is that the decimal division of time is a necessary reform and that a few years will see it established, if the needed instruction is given in the schools, and scientific societies and writers add, in parenthesis, the decimal value of the minutes and seconds as now used: *e. g.*, 8.30 P.M. (decimal time 85$^{\text{cés}}$, 4). The Geographical Society and the Society of Natural History, of Toulouse, have practised this reform since the year 1894.

*Les Restes de la Civilisation Hindoue à Java, par Jules Leclercq, Correspondant de l'Académie Royale de Belgique. (Extrait du Bulletin de l'Académie Royale Belgique.)*

M. Leclercq had cherished the idea of approaching the great temple of Boro-Budur by moonlight, but the moon was hidden by dense clouds when he reached the ruins, and it was in the early morning that he climbed the steps to the top of the monument.

Thence he looked down on the chaos of terraces and cupolas, of

galleries and cornices, set in the wonderful verdure of the valley, and far away to the tops of the mountains just touched by the rays of the rising sun. A scene to be remembered.

Neither Angkor Wat, nor temple of India equals, in M. Leclercq's judgment, the great Buddhist ruin, the work of a genius endowed with surprising vigour of conception.

Boru-Budur and Tjandi Mendoet are the two purely Buddhist temples in Java; the other ruins belong to the followers of Brahma. The most remarkable is the group of Parambanan, discovered 100 years ago. They are covered with sculptures representing scenes of the Hindoo mythology.

The Javanese, though Mohammedans, offer incense and flowers to these figures of their ancient gods, and M. Leclercq saw a woman bow down before one of the images and dedicate her child to it.

It is not easy to agree with the author's closing denunciation of Islam as the foe of architecture:

"This deadly religion, imposed by the sword, has destroyed the creations of genius and the masterpieces of art in all the countries of the ancient world into which it has penetrated; from the shores of the Bosporus to those of the Indian Archipelago, the Koran reigns over ruins."

*Volcanoes of North America: A Reading Lesson for Students of Geography and Geology, by Israel C. Russell. The Macmillan Co., 1897. $4. pp. XIV + 346.*

The most recent of the monographs for teachers from the pen of Prof. I. C. Russell considers the Volcanoes of North America, and is a valuable addition to geographic literature. The previous volumes on the Lakes and Glaciers of North America were devoted to topics concerning which the available literature was large but much scattered. In the volume at hand the author has given us a treatise on a topic whose literature has not been readily available, and the volume fills, as it were, a greater want than either of its predecessors.

The book opens with a lengthy and interesting account of the Types of Volcanoes, giving us the basis of primary classification, according to origin, followed by a brief summary of the features in the life history of volcanoes, whereby the subdivision is readily made into young, mature and old. This is the arrangement now used in physiography for the ready classification of any type of land form.

The remaining portions of Chapter I. deal with Characteristics of the Products of Volcanoes; Profiles of Volcanic Mountains;

Structure of Volcanic Mountains; Erosion of Volcanic Mountains; Subterranean Intrusions; and Characteristics of Igneous Rocks.

The careful reader can gain from this first third of the book the principal facts regarding volcanic phenomena, which are illustrated and applied in the later chapters dealing with the General Distribution of the Active and Recently Extinct Volcanoes of North America; Volcanoes of Central America; of Mexico; and of United States and Canada.

The last chapters are devoted to Deposits of Volcanic Dust; Theoretical Considerations; and the Life History of a Volcano.

The general reader will find every chapter full of help and interest, and the teacher will find the whole book a source of reference that should be at hand. Those who may not care to follow the theoretical considerations in a field where so much is still unknown, will find the greater part of the book well worth continuous reading. The last chapter on the Life History of a Volcano appeals to the imagination in a way that is most helpful even to the specialist in geography. Indeed the chapter is an excellent summary of the whole book, written in such a pleasing manner that the facts abide with the reader without difficulty. By comparison the book is, on the whole, not so satisfactory as its predecessors, as the reader feels that it is more of a compilation than the monographs on Lakes and Glaciers.

The typography is clear and pleasing, and the mistakes are few and not serious. The book is very attractive in its general appearance, as well as in its content. The illustrations, which are numerous, deserve more than a word of mention, for they have been carefully selected and very clearly printed. Many of the reproductions are of phenomena not generally illustrated in text-books, and hence are especially serviceable for teachers and students. The price of the book puts it perhaps beyond the reach of the common-school teacher, which is unfortunate. It is a book to which every teacher should have access, and surely should be ranked among the books of the year chosen for a village or any library. R. E. D.

*First Book of Physical Geography. By Ralph S. Tarr. The Macmillan Company, 1897, pp. 368.*

Prof. Tarr's First Book in Physical Geography resembles very strongly his previous successful book entitled Elementary Physical Geography. The order of treatment is essentially the same, and the amount of attention given to the different chapters varies but very slightly. The First Book, indeed, is so little less simple than

its predecessor that one can hardly see any pedagogic reason for its existence.

The book is so inclusive that naturally no very detailed or complete consideration can be given to any one topic. The value of such a book would be much increased were there fewer topics and more consideration of those few. For instance, such a brief review as Prof. Tarr gives of the tides is very inadequate, and tends to give no clear conception of the causes of these great ocean movements. Such a topic should not be introduced if there be any danger of leaving the student befogged in his impressions, or with the feeling that he knows it all.

The maps and illustrations are an improvement over those in the preceding book; are better selected and better executed. There are very few that are clear only to the eye of the learned geographer or geologist. The typography is good and pleasing, and the printer's errors are few. Yet the book shows that its preparation was hasty, and that the author has no clean-cut images of certain topics that he considers. Such an error as that concerning the location of the magnetic pole would seem to show that the author has not outlived the effects of studying Mercator maps before he had gained a globe idea of the world.

The book is attractive and will undoubtedly have a wide circulation. The high-school teacher qualified to use either book will, however, find the Elementary Book more satisfactory in some ways.

The book of questions and suggestions that has just appeared as an addendum to the text is helpful and timely, but it does not make the book complete. We have yet to see the Elementary Physiography that will be elementary in fact as well as in name, and complete and logical as far as it goes. We were disappointed in the book in question not to find it, as had been announced, written for the upper grades of grammar schools. There is still need for such a book along the lines Prof. Tarr has followed, but arranged from the laboratory standpoint.

R. E. D.

*Die Verwendbarkeit von Luftballons zu Forschungszwecken in unseren Schutzgebieten. Von Otto Baschin, Assistent am Kgl. Preuss. Meteorologischen Institut.* (*Sonderabdruck aus Nr. 3 der Deutschen Kolonialzeitung, Jahrgang, 1898.*)

This paper is an argument for the use of the captive balloon as an aid to exploration, especially in such a land as New Guinea, where navigable rivers offer a means of access to the far interior of the country. The advantage of being able to survey a broad ex-

panse of territory from an elevated point is obvious; it must be left to experience to show whether much can be done with the balloon in the densely-wooded tropical regions.

*Le "Appearances of Land" nella Zona Antartica, per Arnaldo Faustini. Roma, presso la Società Geografica Italiana, Via del Plebiscito, 102. 8vo. (1898.)*

Signor Faustini divides the Antarctic region, geographically, into three parts:

1. Lands, fairly well known as to their configuration.
2. Lands, the existence of which is still in doubt.
3. Parts altogether unknown.

Termination Land, reported and named by Wilkes as seen on the 16th of February, 1840, has not since been reported. Capt Nares, in the *Challenge*, in 1874, found bottom at a depth of 1,300 fathoms within 15 miles of the position assigned to Termination Land, which could not be seen even from the masthead, though pack ice and many bergs seemed to indicate the vicinity of land.

Signor Faustini concludes that Termination Land does not exist.

D'Urville's Clarie Land (Cöte Clarie), is identified with Wilkes's High Land, assigned to a different position.

Several other shadowy appearances of land in the Antarctic are described, including Capt. Morrell's New South Greenland, discovered in February, 1822, and Signor Faustini thinks it desirable that navigators in those waters should lend their aid in the search for these phantoms. There can be no doubt that every voyager in the Antarctic will make his contribution to the stock of knowledge.

*Stanford's Compendium of Geography and Travel. (New Issue.) North America, Vol. I. Canada and Newfoundland. By Samuel Edward Dawson, Litt. D. (Laval), F.R.S.C. Maps and Illustrations. London, Edward Stanford, 26 and 27 Cockspur Street, Charing Cross, S.W. 1897. 8vo.*

Dr. Dawson presents in this volume a concise account of the physical characteristics of Canada and Newfoundland, respectively the first in rank and the oldest of British colonies; but this, he says in his preface, is not the sole object of the book. He has wished also to show why these great regions are still subject to Queen Victoria, and why the "Dominion of Canada has as fair a prospect "of continuance as any other community on the two continents of "the Western Hemisphere."

His preface ends with this declaration:

> The Dominion of Canada stands on the Western Continent for a principle—the dominant principle of the Anglo-Norman race—of steady advance in orderly self-government, growing, as the trees grow, without precipitation or even haste, but never pausing and never retrograding; therefore the Canadian people take little interest in self-appointed prophets or in doctors of destiny, but they carry on their work year by year, as duty calls, leaving the result to that controlling Power which has kept them safe in the past, and is able to do so in the future.

This is worthily said, and the reader is glad to miss, for once, the obtrusive Anglo-Saxon.

Dr. Dawson revises the boundary question and asserts that the Canadians are dissatisfied with their southern frontier line. It may well be. Few nations think they have enough.

As a composition the book deserves high praise. It gives an intelligent and sufficient account of the native races, the discovery, the settlement, the history, the resources and the development of British America, with useful bibliographical notes to each chapter.

Those who turn to it for statistical information will soon find themselves reading it for pleasure.

# ACCESSIONS TO THE LIBRARY.

## January–February, 1898.

### BY PURCHASE.

Les Civilisations Tunisiennes, par Paul Lapie, Paris, 1898, 8vo; Almanach de Gotha, Gotha, 1898, 8vo; An Introduction into Geography, both Ancient and Moderne, Philip Cluverius (translated by H. Stubbs), Oxford, 1657, 8vo; Philippi Cluverii Introductio in Universam Geographiam, etc., Amstelodami, 1697, 4to; The Mogul Emperors of Hindustan, by Edward S. Holden, New York, 1895, 8vo; Kokoro: Hints and Echoes of Japanese Inner Life, by Lafcadio Hearn, Boston and New York, 1896, 12mo; The Christian Topography of Cosmas, an Egyptian Monk, translated, etc., by J. W. McCrindle, London (Hakluyt Society), 1897, 8vo; The Dictionary of National Biography, edited by Sidney Lee, Vol. 53, London, 1898, 8vo; Japan as we saw it, by M. Bickersteth, London, 1893, 8vo; Rambles and Studies in Bosnia-Herzegovina and Dalmatia, by Robert Munro, Edinburgh, 1895, 8vo; China and Her Neighbours, by R. S. Gundry, London, 1893, 8vo; An Artist's Tour, by B. Kroupa, London, 1890, 8vo; The Ancient Volcanoes of Great Britain, by Sir Archibald Geikie, London, 1897, 2 vols., 8vo; The Peasant State: An Account of Bulgaria in 1894, by Edward Dicey, London, 1894, 8vo; The Lake Dwellings of Europe, by Robert Munro, London, 1890, 8vo; Soldiering and Surveying in British East Africa, 1891–1894, by Major J. R. L. Macdonald, London, 1897, 8vo; The Two Americas, by Sir R. L. Price, London, 1877, 8vo; The Land of the Almighty Dollar, by H. Panmure Gordon, London (1892), 8vo; More about the Mongols, by James Gilmour, London, 1893, 8vo; The Growth of Freedom in the Balkan Peninsula, by J. G. C. Minchin, London, 1886, 8vo; Tahiti, the Garden of the Pacific, by Dora Hort, London, 1891, 8vo; Across the Border, or Pathân and Biloch, by Edward E. Oliver, London, 1890, 8vo; The New Siberia, by Harry de Windt, London, 1896, 8vo; The Deserts of Southern France, by S. Baring-Gould, London, 1894, 2 vols., 8vo; The Downfall of Prempeh, by Major R. S. S. Baden-Powell, London, 1896, 8vo; Thirty Years of Shikar, by Sir Edward Braddon, Edinburgh, 1895, 8vo; An Indian Eye on English Life, by Behramji M. Malabári, Westminster, 1893, 8vo; Sunshine and Storm in Rhodesia, by F. C. Selous, London, 1896, 8vo; White Conquest, by W. H. Dixon, London, 1876, 2 vols., 8vo; From the Pyrenees to the Channel in a Dogcart, by C. E. Acland-Troyte, London, 1887, 8vo; European Military Adventurers of Hindustan, 1784–1803, by Herbert Compton, London, 1892, 8vo; Through America, by W. G. Marshall, London, 1881, 8vo; Human Nature in Rural India, by R. Carstairs, Edinburgh, 1895, 8vo; With Kelly to Chitral, by W. G. L. Beynon, London, 1896, 8vo; Slavonic Provinces south of the Danube, by William Forsyth, London, 1876, 8vo; Romance of Isabel, Lady Burton, Told in Part by Herself and in Part by W. H. Wilkins, London, 1897, 2 vols., 8vo; North-Eastern France, by Augustus J. C. Hare, London, 1890, 8vo; Russian Rambles, by Isabel F. Hapgood, London, 1895, 8vo; Men, Mines and Animals in South Africa, by Lord R. S. Churchill, London, 1892, 8vo; My Canadian Journal, 1872–8, by the Marchioness of Dufferin and Ava, London, 1891, 8vo; Here and There in Italy, by Linda Villari, London, 1893, 8vo; The Land of the Dollar, by G. W. Steevens, Edin-

burgh, 1897, 8vo; Li Hungchang, by Robert K. Douglas, London, 1895, 8vo; Five Years in Madagascar, by Francis C. Maude, London (1895), 8vo; Vignettes from Finland, by A. M. C. Clive-Bayley, London, 1895, 8vo; Outre-Mer, Impressions of America, by Paul Bourget, London, 1895, 8vo; Travel and Adventure in Northern Queensland, by A. C. Bicknell, London, 1895, 8vo; Turkey and the Armenian Atrocities, by Edwin M. Bliss, London, 1896, 8vo; The Real Japan, by Henry Norman, 2d Edition, London, 1892, 8vo; Among the Cannibals of New Guinea, by S. McFarlane, London, 1888, 8vo; In and Beyond the Himalayas, by S. J. Stone, London, 1896, 8vo; Face to Face with the Mexicans, by Fanny Chambers Gooch, London, 1887, 8vo; China Past and Present, by R. S. Gundry, London, 1895, 8vo; South Eastern France, by A. J. C. Hare, London, 1890, 8vo; The Scenery of Scotland, by Archibald Geikie, 2d Edition, London, 1887, 8vo; The Story of a Dacoity, etc., by G. K. Betham, London, 1893, 8vo; Eastern Persian Irak, by A. Houtum-Schindler, London, 1896, 8vo; Memorandum on the Royal Geographical Society's New Map of Persia, by George Curzon, London, 1892, 8vo; The Pamirs and the Source of the Oxus, by George Curzon, London (1897), 8vo; Notes on the Kuril Islands, by H. J. Snow, London, 1897, 8vo; British New Guinea: Country and People, by Sir W. MacGregor, London, 1897, 8vo; Index to the Fourteen Volumes of the Proceedings of the Royal Geographical Society, New Series, 1879–1892, London, 1896, 8vo; Catalogue of the Library of the Royal Geographical Society, to Dec., 1893, compiled by Hugh Robert Mill, London, 1895, 8vo; In the Northman's Land, by Maj. A. F. Mockler-Ferryman, London, 1896, 8vo; Stanford's Compendium of Geography and Travel (New Issue): Australasia, Vol I, by A. R. Wallace, Vol. II, by F. H. H. Guillemard, London, 1893–94, 8vo; Asia, by A. H. Keene, London, 1896, 2 vols., 8vo; Africa, by A. H. Keene, London, 1895, 2 vols., 8vo; North America, Canada and Newfoundland, by S. E. Dawson, London, 1897, 8vo.—Italy, from the Alps to Mount Etna (edited by T. A. Trollope), London (1888), 4to; East and West, by Sir Edwin Arnold, London, 1896, 8vo; Sir Samuel Baker: A Memoir, by T. D. Murray and A. Silva White, London, 1895, 8vo; From Everglade to Cañon, 1836–1875, by Theo. F. Rodenbough, New York, 1875, 8vo; De Zieke Reiziger, or Rambles in Java and the Straits, London, 1853, 8vo; On Dutch Waterways, by G. Christopher Davies, London (1886), 4to; The Vikings of Western Christendom, A. D. 789 to A. D. 888, by C. F. Keary, London, 1891, 8vo; The Chronicle of James I, King of Aragon, translated by John Forster, London, 1883, 2 vols., 8vo; Gheel, the City of the Simple (by Mrs. William Pitt Byrne), London, 1869, 8vo; Tenerife and Its Six Satellites, by Olivia M. Stone, London, 1887, 2 vols., 8vo; Syrian Stone-Lore, by C. R. Conder, London, 1886, 8vo; A Lady's Cruise in a French Man-of-War, by C. F. Gordon Cumming, Edinburgh, 1882, 2 vols., 8vo; Ancient Stone Implements, Weapons and Ornaments of Great Britain, by John Evans, New York, 1872, 8vo; South Africa, by J. Stanley Little, 2d Edition, London, 1887, 8vo; Histoire Abrégée des Traités de Paix, par C. G. de Koch et F. Schoell, Bruxelles, 1837–1838, 4 vols., 4to; Cositas Españolas, by Mrs. Harvey, 2d Edition, London, 1875, 8vo; Map of the State of New York, Simeon De Witt, Surveyor General, Boston, 1802, 6 sheets; Map of the District of Maine, Massachusetts, Osgood Carleton, Boston, 1802, 4 sheets; Map of Massachusetts Proper, Osgood Carleton, Boston, 1802, 4 sheets; The London Catalogue of Books, 1810-1831, London, 1831, 8vo; The London Catalogue of Books, 1831–1855, London, 1855, 8vo; The English Catalogue of Books, 1835–1863, London, 1864, 8vo; Du Tonkin aux Indes, par le Prince Henri d'Orléans, Paris, 1898, 4to; The Jesuit Relations and Allied Documents, edited by Reuben Gold Thwaites, Vols. XI, XII, XIII and XIV, Cleveland, 1898, 8vo; Golden Alaska: A Complete Account to Date of the Yukon Valley, by Ernest Ingersoll, Chicago and New York, 1897,

16mo; Klondike, a Manual for Gold-Seekers, by Çharles A. Bramble, New York (1897), 16mo; The Races of Afghanistan, by H. W. Bellew, Calcutta, 1888, 8vo; The Land of Ararat, London, 1893, 8vo; The Garden of India, or Chapters on Oudh History and Affairs, by H. C. Irwin, London, 1880, 8vo; The Turks in India, by H. G. Keene, London, 1879, 8vo; Events in the Taeping Rebellion, reprints of MSS. copied by General Gordon, edited by A. Egmont Hake, London, 1891, 8vo; Voyages d'Alex.dre Mackenzie dans l'Intérieur de l'Amérique Septentrionale, etc., traduits de l'Anglais par J. Castéra, Paris, An X—1802, 3 vols., 8vo; Recueil de Cartes, Plans et Vues relatifs aux Etats-Unis et au Canada, 1631–1731, A.-L. Pinart (Editor), Paris, 1893, folio; Galerie Américaine du Musée d'Ethnographie du Trocadéro, E. T. Hamy, Paris, 1897, 2 parts, folio; A Chorographical and Statistical Description of the District of Columbia (by D. B. Warden), Paris, 1816, 8vo; Le Mexique Tel Qu' Il Est, par Emmanuel Domenech, Paris, 1867, 12mo; Two Years in Oregon, by Wallis Nash, New York, 1882, 12mo; Hours of Exercise in the Alps, by John Tyndall, New York, 1872, 12mo; Andrée: Au Pôle Nord en Ballon, par H. Lachambre et A. Machuron, Paris (1897), 16mo; The Land of the Midnight Sun, by Paul B. Du Chaillu, New York (1888), 2 vols., 8vo; Bermuda, a Colony, a Fortress and a Prison, London, 1857, 8vo; Our Hundred Days in Europe, by O. W. Holmes, Boston, 1887, 8vo; Historical and Biographical Atlas of the New Jersey Coast, T. T. Price, T. F. Rose and H. C. Woolman, Philadelphia, 1878, 4to; Year Book of British Columbia and Manual of Provincial Information, by R. E. Gosnell (with maps in case), Victoria, B. C., 1897, 8vo; Travels from Moscow, by Nicolai Karamsin, London, 1803 (3 vols. in 1), 8vo; The Rob Roy on the Baltic, by J. Macgregor, 9th Edition, London, 1892, 8vo; The Miracle Play of Hasan and Husain, by Sir Lewis Pelly, London, 1879, 2 vols., 8vo; Schliemann's Excavations, by Dr. C. Schuchhardt, translated by Eugénie Sellers, London, 1891, 8vo; An Account of Shelley's Visits to France, Switzerland and Savoy, by Charles I. Elton, London, 1894, 8vo; Our Home in Aveyron, by G. C. Davies and Mrs. Broughall, London, 1891, 8vo; Economic Geology of the United States, by R. S. Tarr, New York, 1894, 8vo; Sources of the Constitution of the United States, by C. Ellis Stevens, New York, 1894, 8vo; Impressions of Turkey during Twelve Years Wanderings, by W. M. Ramsay, London, 1897, 8vo; Deutscher Kolonial-Atlas, von Paul Langhans, Gotha, 1897, folio; Historical Collections of Georgia, by George White, New York, 1854, 8vo; Collections of the Georgia Historical Society, Vol. III, Savannah, 1873, 8vo; China: Political, Commercial and Social, by R. Montgomery Martin, London, 1847 (2 vols. in 1), 8vo; Tchay and Chianti, or Wanderings in Russia and Italy, by W. St. Clair Baddeley, London, 1887, 8vo; Narrative of the Wesleyan Mission in Jamaica, by Peter Duncan, London, 1849, 8vo; The Canadian North-West, etc., by G. Mercer Adam, Toronto, 1885, 8vo; History of the British West Indies, by Bryan Edwards, 5th edition, London, 1819, 5 vols., 8vo, and Atlas and Plates, 1818, 4to; Letters on Yellow-Fever, Cholera and Quarantine, by Alexander F. Vaché, New York, 1852, 8vo; The History of the Anglo-Saxons, by Sharon Turner, Paris, 1840, 3 vols., 8vo; Atlas Geographus, London, 1711, 4to; Retrospect of Western Travel, by Harriet Martineau, London, 1838, 3 vols. 12mo; The American Coast Pilot, by Edmund M. Blunt, 17th Edition, New York, 1854, 8vo; History of the Indian Tribes of Hudson's River, by E. M. Ruttenber, Albany, 1872, 8vo; Natural Selection and Tropical Nature, by A. R. Wallace, London, 1895, 8vo; Sir Walter Ralegh, by Martin A. S. Hume, London, 1897, 8vo; Everyday Life in Turkey, by Mrs. W. M. Ramsay, London, 1897, 8vo; Sir Walter Ralegh, by John Buchan, Oxford, 1897, 8vo; Twenty Years on the Saskatchewan, by the Rev. William Newton, London, 1897, 8vo; Gold Fields of the Klondike, by John W. Leonard, London (1897), 8vo; Pioneers of the Klondike, by

M. H. E. Hayne and H. West Taylor, London, 1897, 8vo; Klondyke: Truth and Facts of the New El Dorado, by A. E. Ironmonger Sola, London (1897), 8vo; Korea and Her Neighbors, by Isabella Bird Bishop, New York, 1898, 8vo; A Students' History of the United States, by Edward Channing, New York, 1898, 8vo; Seven Years in Sierra Leone, by Arthur T. Pierson, New York (1897), 12mo; South American Sketches: A Visit to Rio Janeiro, etc., by Thomas W. Hinchcliff, London, 1863, 8vo; Delagoa Bay, by Rose Monteiro, London, 1891, 8vo; Observations on the Ancient and Present State of the Islands of Scilly, etc., by William Borlase, Oxford, 1756, 4to; La Crète Ancienne et Moderne, par Charles Laroche, Paris, 1898, 18mo; The Ancient Egyptian Doctrine of the Immortality of the Soul, by Alfred Wiedemann, New York, 1895, 8vo; Chronicles of Border Warfare, by Alexander S. Withers, Clarksburg, Va., 1831, 8vo; Through Holland, by Charles W. Wood, London, 1877, 8vo; Buddhism, its History and Literature, by T. W. Rhys Davids, New York, 1896, 8vo.

BY GIFT.

*From S. P. Avery:*

Voyage à la Nouvelle Galles du Sud, à Botany Bay, au Port Jackson, en 1787, 1788, 1789, par John White; Traduit de l'Anglais, par Charles Pougens, A Paris; An 3 (1795), 8vo; Antwerpia (coloured plan of the City, 16th Century), s. l., s. a., sheet; Amstelredamum (coloured plan of the City, 16th Century), s. l., s. a., sheet; Amsterdam, view, London, 1814, sheet; Fridtjof Nansen (Swedish Medal, bronze), Marco Polo (bronze Medal) Nona Riunione degli Scienziati Italiani, Venezia, 1847.

*From L. J. Burpee, Secretary, Ministry of Justice, Ottawa:*

Regulations governing Placer Mining, Provisional District of the Yukon, Ottawa, 1898, 8vo (2 copies); The Klondike Official Guide, by Wm. Ogilvie (with map by W. I. Jennings), Toronto, 1898, 8vo.

*From General J. Watts de Peyster:*

Mandalay to Momien, by John Anderson, M.D., etc., London, 1876, 8vo.

*From Frederick G. Jackson, London:*

Map of Franz Josef Land, showing Journeys and Discoveries of Frederick G. Jackson, Leader of the Jackson-Harmsworth Expedition, 1894–7 (London), 1897, sheet.

*From S. P. Langley, Secretary of the Smithsonian Institution, Washington:*

The Smithsonian Institution, 1846–1896, edited by George Brown Goode, Washington, 1897, 8vo.

*From Jules Leclercq, Author:*

Voyage aux Volcans de Java, 1895.—Bruxelles, 1897. (Reprint.)

*From Townsend MacCoun, Author:*

The Holy Land in Geography and in History, New York, 1897, 2 vols., 16mo.

*From the Northern Pacific Railroad:*

The Klondike Gold Fields. Map of Alaska.

*From the Pacific Steam Whaling Company, San Francisco, Cal.:*

Pacific Steam Whaling Company's Map of Alaska, San Francisco (1897), sheet.

*From E. L. Plumb:*

Tratado de Limites entre Los Estados-Unidos Mexicanos y Honduras Britanica (Edicion Oficial), México, 1897, square 8vo.

*From Harold Raasloff:*

Voyage d'Exploration en Indo-Chine, 1866–1868, par Francis Garnier, Paris, 1873, 2 tomes, 4to, Atlas, 2 tomes, folio.

*From Chandler Robbins:*

Map of Alaska and Portions of the Northwest Territory, showing Routes to the Gold Fields, Chicago, 1897, sheet.

*From Dr. A. Voeltzkow, Author:*

Wissenschaftliche Ergebnisse der Reisen in Madagaskar und Ostafrika, 1889–1895, Frankfurt a. M., 1897, 4to.

## NOTES AND NEWS.

In his forthcoming book, NORTHWARD, to be published by the Frederick A. Stokes Company about the 1st of May, Mr. Peary will tell the whole story of his work in North Greenland.

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Dr. Carl Lumholtz has brought out in the *Bulletin* of the American Museum of Natural History (Vol. X, Article 1), a paper on the Huichol Indians, a tribe numbering about 4,000, living in the northwestern part of the State of Jalisco. Their territory is about forty miles long and from twenty to twenty-five miles in width, in the heart of a very mountainous region.

There are no priests in the country, and Dr. Lumholtz says there is probably no tribe in Mexico where the ancient beliefs have been so well maintained as there.

MEETINGS OF THE SOCIETY.—On the 14th of March Dr. Titus Munson Coan will deliver a lecture on The Hawaiian Islands: the Country and the People.

At the meeting to be held April 11, Mr. Clarence Pullen will read a paper on The Mingling of the Races in Aztlan.

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With the present number of the BULLETIN are printed the Charter and By-Laws of the Society, as amended.

## TRANSACTIONS OF THE SOCIETY.

JANUARY–FEBRUARY, 1898.

The Annual Meeting of the Society was held at Chickering Hall on Monday, January 17, 1898, at 8.30 o'clock, P.M.

Vice-President Tiffany in the chair.

The following persons, recommended by the Council, were elected Fellows of the Society:

Frederick Potter.
J. Baxter Upham, M.D.
William Augustus Walker.
Edward K. Dunham, M.D.
George H. Fearons.
William B. Wait.
John A. Woods.
Samuel Untermyer.
R. P. Whitfield.
Reginald Young.
Rev. Ralph L. Brydges, Islip, N. Y.
John McAlan.
Rev. D. J. M'Millan.
W. H. Carmalt, New Haven, Conn.
Prof. Thomas L. Cottin, Darlington, S. C.
William T. Simpson.
Edward Weston, Newark, N. J.
Mrs. Frances Newbury Bagley, Detroit, Mich.
J. W. Clous, Lt.-Colonel, U. S. A.
Eugene B. Cook, Hoboken, N. J.
Rev. Francis Goodwin, Hartford, Conn.
Jacob L. Greene, Hartford, Conn.
Robert J. Hubbard (Life), Cazenovia, N. Y.
Homer N. Lockwood.
Prof. Henry Ferguson (Life), Hartford, Conn.
Prof. James M. Hoppin, D.D., New Haven, Conn.
Solomon Lincoln, Boston, Mass.
Harold P. Goodnow (Life), Fort Snelling, Minn.
Hon. John A. King (Life).
D. W. Thompson.
Joseph Obermeyer.
A. Beekman Cox, Cherry Valley, N. Y.
Samuel Swett Green, Worcester, Mass.
Prof. William H. Burr.
Charles H. Miller, M.D.
James M. Lamberton, Concord, N. H.
William Beer, New Orleans, La.
Mrs. Frederic Goodridge.
Paul Eve Stevenson, Germantown, Pa.
Edwin S. Marston.
George R. Schieffelin (Life).
B. Lowenstein.
James W. Davidson, Tamsui, Formosa, Japan.
Richard Hodgson, Boston, Mass.
Rev. Horatio Oliver Ladd, Jamaica, N. Y.
Adolph W. Magerhans.
Theodore A. Blake, New Haven, Conn.
J. C. Bancroft Davis, LL.D., Washington, D. C.

The Annual Report of the Council was presented and read:

*To the American Geographical Society:*

The Council respectfully submits the following Report for the year 1897:

The number of Fellows on the 1st of January was 1,069. The number added during the year was 147. The losses by death, resignation, etc., were 77, and the total fellowship on the 31st of December was 1,139, of which number 294 were Life Fellows.

The finances of the Society continue to be in a healthy condition. For details of receipts and expenditures reference is respectfully made to the report of the Treasurer, herewith submitted. The house now occupied by the Society is too small for its needs and is not fire-proof; the funds do not, however, as yet warrant the purchase of land and the erection of a suitable building thereon.

On the 3d of April the Council, by unanimous vote, awarded the Cullum Geographical Medal to Fridtjof Nansen, for his voyage in the *Fram*, and his sledge journey in the unknown polar sea to 86° 14′ N., MDCCCXCIII–MDCCCXCVI.

It has been decided to issue the Society's Bulletin hereafter five times a year, viz.: February 28, April 30, June 30, October 31 and December 31. There will be no change in the form of the publication.

The additions to the Library number 3,494, viz.: Books 794, Pamphlets and Periodicals 2,475, Atlases 14, Maps and Charts 211.

All of which is respectfully submitted.

(Signed) HENRY PARISH,
*Chairman.*

NEW YORK, Jan'y 8, 1898.

The report of the Treasurer was then presented and read:

REPORT OF THE TREASURER FOR THE YEAR 1897.

GENERAL FUND.

*To the American Geographical Society:*

| | | |
|---|---|---|
| The Treasurer respectfully reports that on January 1, 1897, the cash on hand, pertaining to the General Fund amounted to | | $2,131.90 |
| During the year the income was: | | |
| From Fellowship Dues | $9,800.00 | |
| From Invested Building Fund | 9,249.37 | |
| | | 19,049.37 |
| | | $21,181.27 |
| The expenditures were: | | |
| For Salaries | 4,880.63 | |
| " Publications | 2,479.17 | |
| " Library | 1,237.41 | |
| " Meetings of the Society | 848.50 | |
| " House and Insurance | 693.50 | |
| " Stationery, Postages and Sundries | 528.55 | |
| Transferred to Building Fund | 8,000.00 | |
| | | 18,667.76 |
| On December 31, 1897, the balance on hand was | | $2,513.51 |

NEW YORK, Dec. 31st, 1897.

WALTER R. T. JONES,
*Treasurer.*

The Committee charged with the duty of selecting candidates for the offices to be filled reported the following:

REPORT OF THE NOMINATING COMMITTEE FOR 1898.

*To the American Geographical Society:*

The Committee appointed by the Council December 4th, 1897, to nominate suitable persons to fill the offices which will become vacant in January, 1898, respectfully recommend the election of the following named gentlemen:

For President—CHAS. P. DALY, LL.D., term to expire January, 1899.
For Vice-President—EGBERT L. VIELE, term to expire January, 1901.
For Treasurer—WALTER R. T. JONES, term to expire January, 1899.
For Recording Secretary—ANTON A. RAVEN, term to expire January, 1901.
For Councillors—LEVI HOLBROOK,
MORRIS K. JESUP,
GUSTAV E. KISSEL,
HENRY PARISH,
JOHN A. HADDEN,
Terms to expire January, 1901.

(Signed) HENRY HOLT,
S. NICHOLSON KANE,
CHANDLER ROBBINS,
*Nominating Committee.*

On motion, duly seconded, Mr. Clinton Roosevelt was authorized to cast the vote of the Society for the candidates and they were declared duly elected.

The Chairman then introduced Prof. D. Cady Eaton, who read a paper entitled, From Cairo to Beni Hassan.

On motion, the Society adjourned.

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A Regular Meeting of the Society was held at Chickering Hall on Monday, February 14, 1898, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows of the Society:

William Salomon.
Arthur H. Hearn.
Harry D. Kohn.
J. Gordon Emmons.
F. C. Cross, Luling, Texas.
Charles H. Sheldon.
Charles Dudley Warner, Hartford, Conn.
W. M. Rexford.
Gen. William H. Seward, Auburn, N. Y.
Howard W. Preston, Providence, R. I.
James Schouler, LL.D., Boston.

W. A. Wadsworth, Geneseo, N. Y.
Walter Thompson, Garrison, N. Y.
Osborn Marcus Curtis.
George Watkinson, Philadelphia.

Alfred C. Harmsworth, of London, was elected an Honorary Member, and Frederick G. Jackson, of London, a Corresponding Member, of the Society.

The Chairman then introduced Mr. Cosmos Mindeleff, who read a paper on the Origin of the Cliff Dwellings.

On motion, the Society adjourned.

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A Special Meeting of the Society was held at Chickering Hall, on Monday, February 21, 1898, at 8.30 P.M.

President Daly in the chair.

The following persons, recommended by the Council, were elected Fellows of the Society:

C. M. Wales, J. B. Reynolds.

The President introduced the speaker of the evening, Dr. Benjamin Howard, who described his observations and impressions during a visit to the Siberian island of Sakhalin.

On motion, the Society adjourned.

# CHARTER OF INCORPORATION.

GRANTED APRIL 13, 1854.

*The People of the State of New York, represented in Senate and Assembly, do enact as follows:*

SECTION 1. George Bancroft, Henry Grinnell, Francis L. Hawks, John C. Zimmerman, Archibald Russell, Joshua Leavitt, William C. H. Waddell, Ridley Watts, S. De Witt Bloodgood, M. Dudley Bean, Hiram Barney, Alexander J. Cotheal, Luther B. Wyman, John Jay, J. Calvin Smith, Henry V. Poor, Cambridge Livingston, Edmund Blunt, Alexander W. Bradford, and their associates, who are now or may become hereafter associated for the purposes of this act, are hereby constituted a body corporate by the name of "The American Geographical and Statistical Society," for the purpose of collecting and diffusing geographical and statistical information.

§ 2. For the purposes aforesaid, the said Society shall possess the general powers and privileges, and be subject to the general liabilities, contained in the third title of the eighteenth chapter of the first part of the Revised Statutes, so far as the same may be applicable, and may not have been modified or repealed; but the real and personal estate which the said Society shall be authorized to take, hold, and convey, over and above its library, and maps, charts, instruments, and collections, shall not at any time exceed an amount the clear yearly income of which shall be ten thousand dollars.

§ 3. The officers of said Society shall be a president, three vice-presidents, a corresponding secretary, a recording secretary, a librarian, and a treasurer, and such other officers as may from time to time be provided for by the by-laws of the said Society.

§ 4. The said Society, for fixing the terms of admission of its members, for the government of the same, for changing and altering the officers above named, and for the general regulation and management of its transactions and affairs, shall have power to form a code of by-laws, not inconsistent with the laws of this State, or of the United States, which code, when formed and adopted at a regu-

lar meeting, shall, until modified or rescinded, be equally binding as this act upon the said Society, its officers, and its members.

§ 5. The Legislature may, at any time, alter or repeal this act.

§ 6. This act to take effect immediately.

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STATE OF NEW YORK, *Secretary's Office.* } *ss.:*

I have compared the preceding with the original law on file in this office, and hereby certify the same to be a correct transcript therefrom, and of the whole of said original law.

[L. S.] Given under my hand and seal of office, at the city of Albany, this thirteenth day of April, one thousand eight hundred and fifty-four.

A. G. JOHNSON,
*Deputy Secretary of State.*

# AMENDED CHARTER.

PASSED APRIL 8, 1871.

STATE OF NEW YORK, NO. 237, IN SENATE. *March* 7, 1871.—Introduced with unanimous consent, by Mr. Bradley; read twice, and referred to the Committee on Literature; reported favorably from said committee, and committed to the Committee of the Whole.

CHAP. 373.

AN ACT in relation to The American Geographical and Statistical Society.

PASSED April 8, 1871.

*The People of the State of New York, represented in Senate and Assembly, do enact as follows:*

SECTION 1. The name or corporate title of the said Society shall hereafter be The American Geographical Society of New York.

§ 2. The object of the said Society shall be the advancement of geographical science; the collection, classification and scientific arrangement of statistics, and their results; the encouragement of explorations for the more thorough knowledge of all parts of the North American continent, and of other parts of the world which may be imperfectly known; the collection and diffusion of geographical, statistical and scientific knowledge, by lectures, printed publications, or other means; the keeping up of a correspondence with scientific and learned societies in every part of the world, for the collection and diffusion of information, and the interchange of books, charts, maps, public reports, documents, and valuable publications; the permanent establishment in the city of New York of an institution in which shall be collected, classified, and arranged, geographical and scientific works, voyages and travels, maps, charts, globes, instruments, documents, manuscripts, prints, engravings, or whatever else may be useful or necessary for supplying full, accurate, and reliable information in respect to every part of the globe, or explanatory of its geography, physical and descriptive; and its geological history, giving its climatology, its productions, animal, vegetable, and mineral; its exploration, navigation, and commerce;

having especial reference to that kind of information which should be collected, preserved, and be at all times accessible for public uses in a great maritime and commercial city.

§ 3. The power given by the act hereby accorded to the said Society, to take, hold, convey, manage, and make use of its real and personal estate, shall be understood as authorizing said Society to take and hold by gift, grant, bequest, devise, subject to all provisions of law relative to devises and bequests by last will and testament, or purchase real estate to the value of three hundred thousand dollars, and to invest its income, or its personal estate generally, so as to produce a regular annual income sufficient for the accomplishment of the purposes set forth in the first section of this act; but said annual income shall not exceed twenty-five thousand dollars annually.

§ 4. The said Society shall make an annual report of its proceedings to the Legislature.

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STATE OF NEW YORK, } *ss.:*
*Office of Secretary of State.* }

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom, and of the whole of said original law.

[L.S.] Given under my hand and seal of office, at the city of Albany, this twenty-second day of May, in the year one thousand eight hundred and seventy-one.

DIEDRICH WILLERS, JR.,
*Deputy Secretary of State.*

## LAWS OF NEW YORK.

### CHAP. 650.

AN ACT allowing the American Geographical Society of New York to take and hold a larger amount of real and personal property than under previous acts relating to that Society.

BECAME a law May 13, 1895, with the approval of the Governor. Passed by a two-thirds vote.

*The People of the State of New York, represented in Senate and Assembly, do enact as follows:*

SECTION 1. The American Geographical Society of New York may hereafter take and hold by gift, grant, purchase, devise or bequest, subject, except in the matter of income, to all provisions of law relative to devises and bequests by last will and testament,

real and personal property to the amount of one million dollars, and any income therefrom accruing, for the uses, purposes and objects of the said society.

§ 2. This act shall take effect immediately.

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STATE OF NEW YORK, }
*Office of the Secretary of State.* } *ss.:*

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom and of the whole of said original law.

JOHN PALMER,
*Secretary of State.*

# BY-LAWS

OF THE

# AMERICAN GEOGRAPHICAL SOCIETY.

AS AMENDED OCTOBER 23, 1897.

THE following By-Laws are hereby established as the rules and ordinances of the American Geographical Society, and all other By-Laws, Rules and Regulations heretofore made are hereby repealed.

## CHAPTER I.

### MEMBERSHIP.

1. The Society shall consist of Fellows and of Honorary and Corresponding Members.

2. Honorary Members shall be chosen on acconnt of their distinction in the science of geography, or of statistics, and not more than three of them shall be elected in any one year.

3. Corresponding Members shall be chosen from those who communicate valuable information to the Society and who have promoted the knowledge of geography, or of statistics.

4. Fellows, Honorary Members and Corresponding Members shall be elected by the Society as follows: All nominations of candidates shall be made in writing at a meeting of the Council by a member thereof. The names of persons thus nominated, if approved by the Council, shall be recommended to the Society for election at its next stated meeting.

5. The name of any Fellow or Member of the Society may, on the recommendation of the Council and by vote of a majority of the members present at a stated meeting of the Society, be dropped from the list; and the name of any Corresponding Member may be dropped from the list by vote of the Council, without reference to the Society.

## CHAPTER II.

### INITIATION FEE AND ANNUAL DUES.

1. Each Fellow of the Society shall, immediately on election, pay an initiation fee of ten dollars, which shall be considered to include his annual dues for the current year.

2. The annual dues of each Fellow thereafter shall be ten dollars, payable in advance on the 1st of January.

3. Any Fellow of the Society, not in arrears, may commute for life all dues, by the payment at one time of one hundred dollars.

4. The name of any Fellow of the Society who has neglected for two successive years to pay the annual dues, or who at any time refuses to pay them, may, by the Council, be dropped from the list.

5. The fiscal year of the Society shall be the calendar year commencing January 1, and ending December 31.

6. Honorary and Corresponding Members shall be exempt from payment of initiation fee and annual dues.

## CHAPTER III.

### OFFICERS.

1. The officers of the Society shall be a president, three vice-presidents, a foreign corresponding secretary, a domestic corresponding secretary, a recording secretary, a treasurer and fifteen councillors; and these together shall form the Council of the Society.

2. All the officers above-named shall be elected by the Society at its annual meeting.

3. No one shall be voted for, for any office, unless he has been nominated by the Council, or unless his nomination, made in writing by at least nine Fellows of the Society, has been conspicuously posted in the office of the Society for ten days prior to the date of the Annual Election.

4. The president and treasurer shall each be elected for one year and until their successors have been elected; and at each annual meeting there shall be elected one vice-president, one secretary, and five members of the Council, each for the term of three years and until their successors have been elected.

5. All officers to be elected may be voted for on one ballot.

6. Any Fellow of the Society, who has been such for twenty days and who is not in arrears for dues, shall be entitled to vote at the annual election.

## CHAPTER IV.

### ANNUAL MEETING.

1. The annual meeting of the Society shall be held on the second Monday in January, or on any other day which may be designated by the Council for the purpose.

2. At the annual meeting the Council shall present a report of the proceedings of the Society during the past year, and the treasurer shall present his annual report.

## CHAPTER V.

### MONTHLY AND SPECIAL MEETINGS.

1. The Society, unless it is at any time specially ordered otherwise by the Council, shall hold a stated meeting for the transaction of business on the second Monday of each month except July, August, September and October.

2. The president, or, in his absence or incapacity, one of the vice-presidents, may, and upon the written request of the Council or of twenty-five members of the Society shall, call a special meeting of the Society by giving three days' notice thereof in two daily newspapers published in the city of New York.

## CHAPTER VI.

### ORDER OF BUSINESS.

1. At stated meetings of the Society the order of proceedings shall be:

Reading of the minutes.
Reports and communications from officers of the Society.
Communications from the Council.
Reports from committees.
Election of members.
Miscellaneous business.
Papers and Addresses.

2. All propositions presented to the Society at any meeting, for action, shall be in writing. A proposition thus presented, when seconded, shall be deemed to be in possession of the Society and open for discussion, but may be withdrawn by the mover at any time before amendment or decision.

3. No member shall speak more than five minutes, nor more than once, upon the same question, until all other members present have had an opportunity to be heard, nor more than twice on any question, unless leave is specially granted by the Society.

## CHAPTER VII.

### QUORUM.

1. At meetings of the Society nine members present shall constitute a quorum.

## CHAPTER VIII.

### COMMITTEES.

1. Each committee authorized by the Society shall consist of three members, who shall, unless otherwise ordered, be appointed by the chairman.

## CHAPTER IX.

### PRESIDING OFFICER.

1. At all meetings of the Society, on the arrival of the appointed hour and the presence of a quorum, the president, or, in his absence, one of the vice-presidents, or, in the absence of all of these officers, a Fellow of the Society shall take the chair and call the meeting to order.

2. The chairman shall have only a casting vote. He shall preserve order and decide all questions of order, subject to an appeal to the Society. At every annual meeting, before the opening of the polls, he shall appoint two tellers of the election. In case of a contest, he may declare the election postponed to the next meeting, in order that a corrected poll list may be prepared by the secretary and verified by the Council; but only one such postponement shall be made.

## CHAPTER X.

### SECRETARIES.

1. It shall be the duty of the Foreign Corresponding Secretary to conduct the correspondence of the Society with individuals and associate bodies in foreign countries.

2. It shall be the duty of the Domestic Corresponding Secretary to conduct the correspondence of the Society with individuals and associate bodies in the United States.

3. In case of vacancy in the office of either of the corresponding secretaries, or in the absence or disability of either of these officers, the duties of either may be performed by the other secretary, or by the librarian.

4. The secretaries shall keep in books at the rooms of the Society copies of all letters written by them, and shall file at the said rooms all letters received by them on behalf of the Society.

5. At each stated meeting of the Council they shall respectively report their correspondence, and read the same or such parts thereof as may be required.

6. The Council may designate a particular officer, or appoint a

committee, to prepare a letter or conduct a correspondence on any special subject.

7. It shall be the duty of the Recording Secretary to give due notice of all meetings of the Society and to attend the same. He shall keep adequate minutes of the proceedings of the Society. He shall give immediate notice to officers and committees of all votes, orders, resolves, and proceedings affecting them or pertaining to their respective duties. He shall at each annual election hand to the tellers a list of the members of the Society entitled to vote. He shall have charge of the seal of the Society and of the charter, by-laws, records and general archives, except so far as they may be placed by the Council in charge of others. He shall sign and affix the seal of the Society to all diplomas, deeds or other documents authorized by the Society or Council.

8. All documents in charge of the secretaries shall be kept at the rooms of the Society, unless otherwise specially ordered by the Council.

## CHAPTER XI.

### TREASURER.

1. The Treasurer shall have charge of all deeds, contracts, bonds, certificates, securities and muniments of title belonging to the Society. He shall collect all dues to the Society and keep the funds safely deposited in some incorporated bank or trust company approved by the Council.

2. Funds so deposited shall be drawn out only by check of the Treasurer, countersigned by the chairman of the Council, or by such other officer as may be designated by the Council for that purpose,

3. The Treasurer shall, prior to the annual meeting of the Society, prepare and submit to the Council for audit a detailed account of his receipts and disbursements during the past year, which account, duly audited and approved, he shall present to the Society at the annual meeting.

## CHAPTER XII.

### COUNCIL.

1. The Council shall have the management and control of the affairs, property, library, and funds of the Society, and shall transact all such business of the Society as is not required to be transacted by the Society at a stated meeting. It shall designate a bank or trust company in the city of New York in which the funds shall be

deposited by the treasurer. It shall have charge of and edit all the publications of the Society.

2. It may adopt rules for its own goverment, not inconsistent with the charter and by-laws of the Society, and appoint such standing and special committees as it may deem proper, and define their duties. It shall appoint the librarians, clerks and other servants of the Society, and fix the powers, duties, privileges and compensation of each. But no appointment shall be made which shall not be revokable at the pleasure of the Council.

3. It shall have power to fill for the unexpired term any vacancy that may occur in its own body or in any of the offices of the Society, and it may declare a vacancy to exist in any office whenever the incumbent thereof is, by reason of absence or otherwise, incapable of performing its duties. It shall have power to declare vacant the seat of any member of its own body (except the president and vice-presidents), who shall have been absent from its meetings for three successive months.

4. The Council may for good cause remit the annual dues of any Fellow of the Society.

5. No member of the Council shall, directly or indirectly, receive any salary or pecuniary compensation for his services to the Society.

## CHAPTER XIII.

### ALTERATION OF BY-LAWS.

No alteration in these by-laws shall be made, unless proposed in writing at a stated meeting of the Society and referred to the Council for consideration, and approved by the Council and adopted by the Society at a subsequent meeting.

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63° 30'
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62° 30'
62°

BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXX 1898. No. 2

# FROBISHER BAY REVISITED.

BY

RUSSELL W. PORTER.

The doubt in the minds of geographers as to whether Frobisher Bay was a closed arm of Davis Straits or a strait opening into a larger body of water to the northwest remained unsettled from the time it was discovered by Martin Frobisher, in 1576, until thirty-seven years ago.

Thinking that the region might possibly hold some clue to the fate of Sir John Franklin's expedition, Charles F. Hall, afterwards Commander of the United States Polar Expedition, visited Baffin Land in 1860, and the next summer entered Frobisher Bay and reached its headwaters. The original object of his expedition was a failure, but his geographical work of locating some five hundred miles of shore line and innumerable islands scattered through the bay, made the trip of permanent value.

Since that time there is no record of white men having explored this bay. Whaling vessels have wintered in Davis Straits to the north of the bay, and of late years a whaling station has been established forty miles from its entrance, but the work of these men was confined to the seaboard in the interest of catching whales.

The idea of again traversing the little-known regions was conceived by the writer in the fall of 1896, on his return from Greenland, during a short stop at a Scotch whaling station in Cumberland Sound.

It was his intention to remain in southern Baffin Land with one companion through the winter, in order to reach by dog sledges the lake region of the interior, and make an extended study of the Eskimos in this vicinity for ethnological purposes.

Provisions and equipment were therefore taken for a fifteen-

months' stay, and the writer, accompanied by Alfred V. Shaw, of Newton Highlands, Mass., embarked at Boston July 19 on the steam-whaler *Hope*. *

The *Hope* coaled at New Campbellton, Cape Breton, passed through the Gulf of St. Lawrence and up the Labrador coast. She crossed the entrance to Hudson's Straits the last day of July, and early on the morning of the 1st of August the party were landed at Cape Haven on the west coast of Baffin Land in latitude 62° 54' N.

From Hall's account of his travels in this region, it is quite evident that the Eskimos were of inestimable service to him, both as guides and in taking advantage of the different conditions of weather, winds and tides, which here especially contribute an important factor in determining just how much territory can be covered in a given time. Twelve natives were therefore hired to accompany the party. The equipment consisted of two whale-boats, rigged with mainsails and jibs, sleeping bags, kerosene oil stoves, and canned provisions. In retrospect it must be admitted that the trip as carried out could not have been accomplished safely without these natives. The tides in the bay vary from twenty to thirty feet, and when setting in opposite directions, as they sometimes do among the islands, create currents which are remarkably erratic and powerful, so that a party new to these regions and alone would be apt to have their boat on the rocks before their journey had scarcely begun. The winds in the same way are to be equally unrelied upon, as they are dependent to a great extent on the configuration of the country for their direction. They may change, as they did several times this summer, to the four points of the compass in a single day's run. The Eskimos, thoroughly familiar with these fickle elements, enable one not only to avoid danger, but to make use of them to advantage.

After a preliminary trip to the head of Cyrus W. Field's Bay the party started on August 11 for Frobisher Bay, taking a southerly course towards Bear's Sound. This sound separates a few large outlying islands marking the northern entrance of the bay from the mainland, and is full of islands. Its easterly entrance, Lupton

* In addition to the above a party of six persons, organized by the writer and composed mostly of college students, joined the expedition for the sport which a summer in this region afforded. It need only be stated here that this party spent a very satisfactory six weeks in and about the bay, there being an abundance of game, including polar bears, reindeer, ducks, ptarmigan and sea trout. The total and remarkable absence of all floe-ice accounted for the disappearance of the walrus, which is only found in the vicinity of floating ice.

Channel, is contracted to a width of half a mile and is impassable when a rough sea from the Atlantic meets a setting-out tide from the sound, a line of breakers forming from shore to shore. Within the sound the currents are moving among the islands in all directions and with great velocity, owing to the tide entering this body at both entrances. The islands rise abruptly from the water, are rounded off and show intact signs of former glacial action. Eider ducks (*Somateria mollissima*) were seen here in great numbers, among which was found one flock of the rare King Eider (*Somateria spectabilis*).*

The first view of Frobisher Bay itself disclosed the Everett chain of mountains on the further side of the bay, which at the entrance is thirty miles broad.

It appeared as a blue line of serrated peaks between which at remarkably regular intervals large glaciers forced their way to the water's edge. Ten of these were then visible, and the eye following them back into the interior could make out the faint white dome of the ice cap outlined against the southern sky.

The course was now changed to the northwest, following up the eastern coast. The land here rises to an almost uniform height of 500 feet. The aspect of the interior from this ridge is one of extreme desolation. The rock, almost void of vegetation, is broken up by frost action to such an extent as to effectually conceal the ledge underneath with a waste of sharp angular blocks piled one upon another. Here and there against hillsides having a northerly exposure were banks of snow which had withstood the summer's heat. This snow was, more properly speaking, of the consistency of ice, the alternate thawing and freezing during summers and winters having brought it to this state. It was not ascertained whether the banks were increasing or diminishing.

The bay along this coast for twenty miles is shallow, a falling tide and a westerly wind causing a dangerous undertow and huge waves which curl and break several miles from shore. Numerous reefs also tend to make this quarter a bad one during rough weather. This area of shoal water is called by the natives "Ickarto."

In latitude 62° 45′ N. the bay indents its eastern coast to a considerable extent, forming the historic body of water known as Countess of Warwick Sound. Here in 1861 Hall found several relics of the Frobisher Expedition of 1578.

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* The identity of this bird was not known until after they had become unfit for preserving as specimens. The natives had removed and eaten the lumps of fat lying on either side of the upper bill where it joins the head.

According to the manuscript accounts of this hardy mariner and some of his officers, they had intended to build a house on one of the islands of the sound and establish a colony of one hundred men, who were to mine iron ore which had been found here the year before. As part of the house had been swept overboard on the outward voyage from England, the project had to be given up. Hall found the remains of a ship's trench and some of the "proofs,"—lumps of iron which had been made by the assayers of Frobisher's Expedition. The island is called "Kodlunarn" by the Eskimos, or "White Man's Island," there being still a tradition among them of a number of ships coming from the east manned by white men.

This sound is only separated from Cyrus W. Field's Bay by two miles of land, and a pass between the mountains at this point becomes a highway in winter for natives who visit the bay from the seaboard. A perfect raised beach, the only one seen in Frobisher Bay, was discovered on one of the mountains north of the sound. It was composed of large rounded bowlders and pebbles, had an elevation of about two hundred feet and extended along the western slope of the mountain for a mile or more. Rounding the southern slope, an exact counterpart was discovered on the eastern side having the same elevation and kind of material.

Continuing up the coast, the land preserves the same general character as that found on entering the bay. The ridges near the coast remained at the usual height of 500 feet, but the view into the interior always presented the same appearance of rolling country, always rock, which rose as it receded until at the horizon the mountains might have an elevation of 1,000 feet.

The valleys always contained a stream of water taking its source from the patches of snow-ice. Vegetation thrived only at rare intervals where rock had disintegrated and formed soil, but in the larger valleys in the vicinity of water-courses, soft and spongy moss was always to be found. In these places, a species of stunted blueberry grows in considerable quantities, the berries being small and almost tasteless and maturing the last of September. Buttercups, primroses, daisies and yellow poppies were also seen in sheltered spots, forming bright bits of color which relieved the monotony of the landscape.

About half-way up the bay the first of a large number of islands which continue on up to the headwaters was reached and a circuitous course taken among them. These islands, composed of mica schist, the predominating rock of this region, contain many polished summits which bear unmistakable marks of glaciation. The general

direction of the striation found on the islands in the middle of the bay was parallel to the bay itself, viz.: northwest and southeast. Strong currents were again encountered among these islands, sometimes so strong that, notwithstanding a strong fair wind was blowing and all sail was set, the shore would have to be resorted to and camp pitched to await a turn of the tide.

Seals frequent the waters here in the winter when "water holes" are formed by the currents, making an opportunity for these animals to come to the surface to breathe. It is a favorite stamping-ground for the Eskimos in winter, who take up their abode here in order to be near the seals, from which they obtain their food, clothing and fuel.

As the headwaters of the bay are neared, the land to the east takes on a more undulating surface and rises to only a slight elevation: islands grow smaller and more numerous.

One night was spent on the end of Becher Peninsula (5th encampment) which divides the head of the bay into two large inlets. That to the east of Becher Peninsula, Hall has designated as Ward's Inlet, while the western body of water, being somewhat larger, he has considered the terminus of Frobisher Bay itself. Our course lay up this arm of the bay. Islands became mere reefs and ledges over which the tide at flood rushed with great violence.

The Sylvia Grinnell River, of Hall, was found to be a stream of considerable importance as compared to other rivers of this locality. Its entrance to the bay was choked with small islands, tide water setting back some three miles to a beautiful falls, which at high water was about fifteen feet high. This river was not traversed beyond the falls, but it could be seen for several miles flowing from the northwest in sinuous curves through a low, almost undulating valley.

Twelve miles west of the Sylvia Grinnell River is a sister stream, the Jordan, which in its physical characteristics is a counterpart of the Grinnell. Its falls, divided by a small island, can only be reached with great difficulty at ebb tide, due to the great amount of tide water setting out into the bay over a wide, shallow, sandy bottom.*

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*The two boats were five hours in making this distance, three miles. This trip against the morning tide seemed to be the only bit of bad judgment shown by the natives during the summer, but is partly explained from the fact that several of their tribesmen were encamped at the falls (their huts had been discovered through the telescope the day before), and they were anxious to meet their people, whom they had not seen since the winter previous. The boats went aground several times, and had it not turned into a veritable race for first place, for this our farthest north, the journey would have probably been given up until the afternoon.

The "Valley of the Jordan," if the size of its river is taken into account, must embrace a large watershed, probably extending well to the southwest towards Hudson's Straits. Its limit in the opposite direction is but a few miles from the river itself, as several long, narrow valleys discharging small streams into the bay were found lying between the two larger rivers. Moreover, the natives stated that Lake Amakdjuak, which drains north into Lake Nettilling and thence west into Fox Channel, was only distant "two sleeps." This expression "two sleeps" referred to journeys taken in summer by Eskimos heavily laden with their effects, and meant not more than thirty miles.

By far the most interesting feature of this valley was the Sillimans Fossil Mount of Hall. This is a limestone table-topped mountain, situated on the western side of the valley not far from tide-water, and lies close against the mountains of Meta Incognita. It forms a striking feature of the landscape, with its white sides silhouetted against the dark mica schist of the chain behind it; and when seen at a distance has the appearance of an immense sandbank extending out from the mountains. On reaching the base of the mountain the sides were found to be tali, which extended nearly to the top, and here the ledge cropped out in several places, making the plateau almost inaccessible except from the south, where it joins the ledge of the mountain side.

SILLIMANS FOSSIL MOUNT.

The view from the top is an extensive one. Jutting into the valley, as the mountain does, one commands an outlook down the bay and through the many islands until they dip to the horizon line.

Below you lies the valley through which the Jordan flows. As its course is traced northwards towards the interior, the Great

Gateway, so-called by Hall, outlines a northern sky and points the way to the great and unknown lake region.

Sillimans Fossil Mount is divided into two parts, brought about by the action of a small stream rising in the chain of hills to the west, and forcing its way out into the valley between the two high banks of crumbling limestone.

THE FOSSIL MOUNTAIN (2D VIEW).

Fossils were collected* mostly from the bed of this brook and the slopes of the smaller mount. They were also found imbedded in the outcropping ledge at the summit of the larger mount, and a few were discovered on the table top

* The writer has received a communication relating to a part of these fossils from Prof. C. Schuchert, of the National Museum at Washington, D. C. It is given here. That part of the collection made by the writer is at the American Museum of Natural History, New York City.

DEAR MR. PORTER :

The fossils collected by Messrs. J. Nilson Carpender, A. Hollis White and Alfred V. Shaw, members of your Frobisher Bay party, at Sillimans Fossil Mount, are very interesting, historically and paleontologically.

As you know the Arctic explorer Charles Francis Hall describes in his "Arctic Researches and Life among the Esquimaux" the discovery of this locality and writes of the abundance of fossils occurring there. However it seems he brought back but six species from Sillimans Fossil Mount. These were studied by R. P. Stevens and his results published in the *American Journal of Science* for 1863. These fossils appear now to be lost.

In the three collections at hand there are seventy species indicating a varied and very well preserved fauna. Of corals there are 7 species, sponges 2, brachiopods 8, mollusca 46, trilobites 6 and cystids 1. You will therefore see that the work of your party added much material to elucidate the geologic history of Baffin Land.

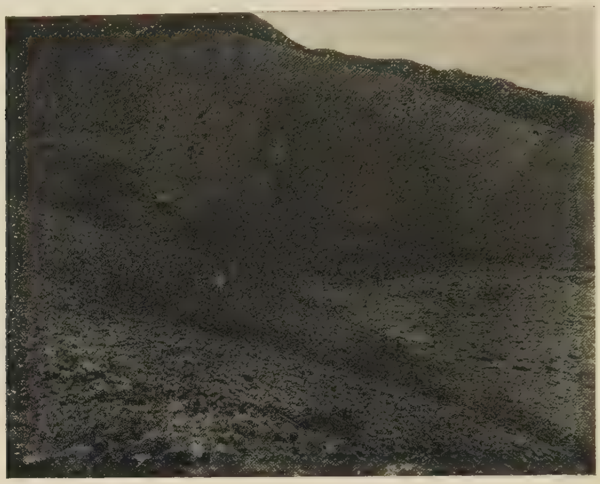
The age of the Baffin Land fossils is Trenton, or the middle part of the Lower Silurian system, and find their nearest relatives in the Galena fauna of Iowa and Minnesota.

The same fauna is also found in Manitoba, but is not so abundantly represented by individuals and species.

Mr. E. M. Kindle, of the Sixth Peary Greenland Expedition, also obtained fos-

itself, which is covered with a thin layer of moss and strewn with granite bowlders of glacial deposit. The height of this fossil formation is 340 feet above high water, instead of 100 feet as given by Hall.

It may be said before leaving this interesting locality that the



SILLIMAN MOUNT.

falls of the Jordan River contain quantities of sea trout,* which are secured by the natives with fish spears.

A native will take his position on the edge of the rocks, just below the falls, in swift water. With spear poised aloft, his eyes glued to the surface of the boiling stream, he awaits the clearing of the water of air bubbles so that he can see the bottom.

At such a time long parallel lines of gray, like the teeth of a comb, can be seen slowly moving forwards and backward, and he

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sils known to occur at Sillimans Fossil Mount from a Missionary "who obtained them from the shore of Lake Kennedy, which lies northwest of the head of Cumberland Sound." You told me of another fossiliferous locality more inland, from Sillimans Fossil Mount, and with the known occurrence of Trenton fossils in Ottawa, Quebec, New York, Illinois, Wisconsin, Minnesota and Manitoba, it is highly probable that there was an almost circumferential deposition of Trenton strata around the nucleus of North America, the Laurentian and Huron rocks of Canada and New York.

CHARLES SCHUCHERT.

U. S. NATIONAL MUSEUM, January 31, 1898.

*It was commonly supposed by those who have visited Baffin Land heretofore that these fish were salmon trout, and it was not until a large specimen had been speared in the vicinity of Signuia Point, and others taken in various parts of the bay, that the fact became known that it was the sea trout and not the salmon (found in Greenland and Labrador) which run up these rivers to spawn.

drives the spear into the midst of them. If he captures one fish in fifty throws he considers himself fortunate, but it is a virtue of the Eskimos to be patient, and it is a rare occurrence if he does not return to camp with at least one of these beautiful fish, which average in weight from five to ten pounds.

Constant spearing often scares the trout out of throwing distance, in which case boys are stationed above and below the spearsman, throwing rocks into the river, thus keeping the school continually moving.

Five families of Innuits had, two days before our arrival, left for the interior to the northwest after cariboo (*Rangifer tarandus*). They had taken their entire equipment with them—guns, ammunition, tents, dogs, children—in fact, everything they possessed except their kayaks. These were left at the falls, inverted and resting on piles of stones. Their destination was the southwest shore of Lake Amakdjuak, where game was most plentiful at this season of the year. Although there were countless signs of cariboo in the vicinity of the Jordan River, the presence of the natives had driven them all away from the seaboard.

At 6 o'clock Thursday morning, August 26, the return journey was commenced, setting a course down the coast of Meta Incognita, on the western side of the bay. Taking advantage of the falling tide, the boats passed out of the Jordan River and over the shoals, where Hall in 1861 experienced a "struggle for dear life."

He describes the place as "boiling and seething mill-races, made by the tide as it rushed along." The sound was like the "roar of the sea raging in a storm." Undoubtedly it is a bad place at low tide, but not at all dangerous when traversed at high water. We saw nothing resembling such conditions as these words painted then, probably because it was nearly high tide.

At 10 A.M. we came in between Bishop's Island and the mainland, and found the water so shoal as to require a stop and await the turning tide before going on to the camping place picked out by the natives. This did not occur until well into the afternoon, allowing plenty of time to ascend to the summit of the ridge and obtain a view of the interior. At an elevation of about 1,000 feet one could look westwards into a valley whose bottom lands were so extensive as to remind one of the Connecticut River Valley between Vermont and New Hampshire. Its two rivers also, uniting into one some three miles from its mouth, had the same banks and about the same breadth as the river cited above. Vegetation appeared to be more abundant here than at any other place as yet

seen during the summer. This stream debouches into the Bay of Rivers.

At the second camp down the coast from the Bay of Rivers an incident occurred which, although insignificant in itself, led to a good deal of the unknown country to the west being thoroughly explored. This was due to two members of the party who had left the boats in the morning, intending to hunt down the coast, and failed to turn up at the camp when night came on. Signal shots were fired through the night and a beacon fire built on the summit of a neighboring ridge. With the dawn, and no signs of the absent ones, the remainder of the party and the entire force of Eskimos scattered up and down the coast and up the passes into the interior. The men were picked up three miles down the coast, but when the party were all congregated at the tent there were many interesting accounts of the country gone over. One member had viewed from a ridge 1,100 feet high a broad valley with its river and sand banks, the river larger even than the one at Bay of Rivers, full of rapids and flowing southeast. Two gaunt, dirty yellow wolves (*Canis occidentalis*, *var. griseo-alba*) were trotting down the shore of this stream, continually stopping and scenting the air in the direction they had come from, as though they had seen others of the party to the north. Another member had visited two lakes, due west of the camp (which probably drained into the river already mentioned), and into which plunged a waterfall of quite imposing dimensions.

That night it was announced to the natives that we intended going down the coast to the glaciers before crossing to the east side of the bay. Their evident disapproval of such a step was quite apparent, as they explained that no Eskimos ever visited that part of the coast, especially in the summer. Moreover, such a trip would necessitate a long stretch for the boats across the bay, without the friendly shelter of islands in which to seek a harbor should a change of weather require it.

However, the opportunity of seeing so much virgin land was too good to be lost, and for the first and only time on the trip were the Eskimos' objections set aside.*

* No mishaps occurred on this section of the trip. The natives evidently thought we were going farther down the coast. As it was, only the northernmost of the glaciers on Meta Incognita was visited, and a course steered across the bay curving to the northwards and passing near the end of Gabriel Island. This curving to the northwards was almost a semi-circle, described by the boats as they beat up into the wind. It serves to show the caution of the natives. Had the course been straight across to the islands and the wind increased, there would have been danger of being blown out into the bay.

With two stops the coast was traversed from Cape Ramelsburg to Watts Bay, a distance of seventy-six miles. The coastal range presented one unbroken line of jagged peaks, having an average elevation of 2,000 feet. With remarkable regularity narrow valleys

EVERETT MOUNTAINS.

ran from the shore towards the interior, hemmed in by cliffs which rose from their tali sheer to the summits. These summits, that is, all the highest ones, were cut squarely off, and at a distance had the appearance of sharp truncated cones. It was very noticeable how easily their table-tops would adapt themselves to a smooth, flowing horizon line if one imagined the gaps between them to be filled up. It seems rational to assume that this range of mountains was covered at one time with an ice-cap of some size, and that, after its retreat, powerful disintegrating forces had been at work cutting out the valleys. The general strike of the rock (gneiss) for the most part was nearly vertical, the mountain sides being crossed in several places by large dykes.

The 13th encampment was at the head of a bay whose existence seems to be entirely ignored on Hall's chart. In fact, the coast of Meta Incognita appears to be quite inaccurately drawn on the chart accompanying Hall's "Arctic Researches." It is not to be won-

dered at, however, as he saw a greater part of it from a distance, and that, too, in the winter, when the snow covered both ice and land. Newell Sound is not so large as represented, and two bays indent the coast north of Griffin Bay and south of the one at which we camped.

This bay (13th encampment) is five miles long, with a uniform width of two miles. At its head there is a small lake, about one mile long, which at high tide becomes part of the bay, and therefore slightly brackish.* The latitude of this bay, by meridian altitude, was found to be 62° 48′ N.

BOAS GLACIER.

Thursday evening, Sept. 4th, the boats entered Watt's Bay (14th encampment), and the tents were pitched on its northern shore, where large circles of stones gave evidence of winter Eskimo encampments. Across the bay, two miles to the southwest, was the blue wall of a glacier, hemmed in on either side by high mountains. On the horizon, back of it, a luminous glare from the ice-cap lit up the fog and mist which was shutting down over the landscape.

The next day, although fog and occasional rain made climbing disagreeable, the glacier was ascended. One mile to the right of

* The Eskimos said there were very large fish in this lake. One native was nearly pulled in by something which had got hold of the other end of his line, only giving up the struggle when the line broke. This was even repeated a second time, and the fish seen, three or four feet long. A few smaller ones were caught and proved to be northern cod.

its face a beautiful waterfall emptied into the bay. From an elevation of 300 feet above high-water this glacial stream slid over the smooth rock in a convex elliptical curve, which at the water's edge was nearly vertical.

FACE OF BOAS GLACIER.

The face of the Boas Glacier* is approximately 150 feet high, and has a frontage of some one hundred yards. The glacier was not discharging to any noticeable extent, there being no bergs in Watts Bay.†

In the centre of the ice stream, and perhaps half a mile from its face, the writer set up a signal pole of bamboo, marking the spot additionally with a pile of rocks. Then cairns were erected on the shore in line with the pole, and sketches of the surrounding locality made for the purpose of identifying the spot in winter.‡

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* Named by the writer in honor of Dr. Franz Boas, of the American Museum of Natural History, New York City.

† The larger glaciers of Meta Incognita probably discharge during the summer, as several large bergs were seen on the other side on our way up the bay. These might, however, have possibly found their way into Frobisher Bay from the Labrador Current.

‡ It was the writer's intention to revisit the glacier in the summer of 1898 to ascertain how far down stream the pole had moved, and in this way get at an approximate rate of flow of the glacier. Circumstances compelling his return to the States left this work scarcely begun, which is to be regretted inasmuch as no one has as yet visited the Meta Incognita glaciers to study their movement.

The Boas Glacier is an easy one to travel on. It has an angle of descent of 15° with the horizon, and on its southern side one can walk directly to the ice-cap above. It can be crossed at almost any point. Its surface is clean and hard, carrying but little detritus, and in September was melting and furrowed by many streams of water. The so-called "pot holes," found in numbers on the Greenland glaciers, were conspicuous by their almost total absence.

At a distance of two miles from the face of the glacier the consistency of its ice changes to that of snow, and half a mile farther on the ice has entirely disappeared as well as the crevasses. The horizon to the west was obscured by fog, but the appearance of the ice-cap at this place was that of rolling plains of snow through which a single nunatak forced itself.

The writer, accompanied by Mr. Shaw, reached this "island of the white sea" after floundering through wet snow knee-deep, and succeeded in reaching its summit, where a cairn was built and a record deposited. It had an elevation above the bay (by aneroid) of 2,380 feet.

The return to Signuia Point, from Watts Bay, was without special interest, as the course was for the most part over familiar ground. The party were stormbound two days in Bear Sound, having made two ineffectual attempts to pass through Lupton Channel, where a line of breakers, due to the setting of the tide against a heavy swell from the Atlantic, checked further progress.

The *Hope* was reached at 5 P.M. of Sept. 12th, and early the next morning she started south, reaching Sydney, Cape Breton, eight days later.

# ORIGIN OF THE CLIFF DWELLINGS.

BY

COSMOS MINDELEFF.

There is no dearth of theories regarding the cliff dwellings, but so few of them are based on actual knowledge of the remains—a knowledge which we now possess—that a revision of the old ideas is in order. Although a cliff ruin was described as long ago as 1850 by Lieut. Simpson, then attached to a military expedition into northern Arizona, practically nothing was known about them then, and in a general way it may be said that our knowledge of these interesting remains dates back only some twenty years, for it was at that time that they were first brought to the attention of the public through the explorations of the Hayden Survey in Colorado and Arizona.

The cliff ruins were at first supposed to be the product of a distinct race, in some way allied to the Aztecs of Mexico, and in the literature of that period we find many picturesque theories regarding them. They were thought to belong to a remote past, and to have been the houses of a part of the people who were left behind in a great migratory movement to the south, the final result of which was the establishment of the Aztec culture about the Lake of Mexico. It was not stated why a part of the people were left behind, nor what became of them afterwards, although some writers have suggested that in the cliff dwellings these people made a last and ineffectual stand against their enemies, who had before driven them to build their houses in the cliffs; in other words, that the cliff dwellings were purely defensive structures. They are still called Aztec ruins in popular accounts, but the term is seldom found in current books.

The study of the cliff ruins was taken up by the Smithsonian Institution about fifteen years ago, and the systematic collection of data was then commenced. It was soon discovered that the ruins and the inhabited villages of the Pueblo Indians pertained to the same people, but to a certain extent the old ideas still cling to the cliff ruins, and there is a strong disposition to consider them a thing apart; if not the product of a distinct tribe, still the result of distinct and exceptional causes. One theory, still to be found in current print,

has it that the cliff dwellings mark an early period in the history of pueblo Indian culture, when the people were few and not as yet aggregated into large villages, and when each little family was compelled to defend itself against numerous and persistent enemies, building their dwellings in almost inaccessible nooks in the cliffs to render their feeble defence more effective. But house building is an art, and in the study of an art the comparative method is the only one to be followed. A comparison, therefore, between the houses of the cliffs and the present homes of the Pueblos shows that the former are in every way equal to the latter, from an architectural standpoint, and that no cultural sequence exists.

According to a later theory the cliff dwellings were defensive structures built by various pueblo tribes at times when the onslaughts of enemies compelled the abandonment of the villages in which they usually lived, and to which they returned when the necessity for such abandonment was passed. Definite traditions of such occupancy have been collected from several tribes, and it may be that some of the cliff ruins were occupied under these conditions. But it is a question whether their origin is to be attributed to such a cause and it is clear that only a minute percentage of the ruins can be explained in this way.

The American Indian, like all other savages, is extremely sensitive to his environment, sensitive to a degree that we who live under different conditions find it difficult to conceive. He is in such close touch with nature that he responds quickly to her varying moods, and in a few generations he comes directly under the sway of the country in which he lives, not so much in his physique as in his arts and in his ideas. The study of an Indian art must be to a large extent the study of the conditions under which that art developed; or, to put the matter in a more concrete form, the origin of the cliff dwellings is to be found in the study of their geographical environment; it is essentially a geographical question, a question of topography and climate.

The cliff dwellings belong to no class in any division of Pueblo architecture, but to a sub-class pertaining more or less to all of them. They had their origin in a peculiar topographic environment acting through certain industrial requirements, and belong to no particular period either in culture or in time. Many of them are undoubtedly very old, others are modern, and the tradition of the native tribes, that Spanish monks were stationed in some of the cliff dwellings, is supported by the ruins themselves. But in order to

obtain an adequate idea of the cliff dwellings some knowledge of Pueblo architecture is necessary.

In a previous BULLETIN of this society I have sketched in some detail the topographic and physical peculiarities of the Pueblo country, so that a slight description will be sufficient now. That country extends from the Colorado Cañon to the Rio Grande Valley and from Salt Lake City beyond our southern border. Within its area of 150,000 square miles there are thirty inhabited villages and thousands upon thousands of ruins.

The relation of this area to the country at large is well shown on a relief map of the latter. The western third of the United States is mountainous and the pueblo country occupies the southern part of that area. Its limits are practically the same as those of the region which geologists call the plateau country, the topographic features of which are strongly marked and fairly consistent throughout. The dominant topographic form is the mesa, there are mesas everywhere; in short, it is the mesa country. The word, which is from the Spanish and means table, is expressive; mesas are flat-topped table lands, sometimes of small area, but often extending for many miles. A typical example is Thunder Mountain, near the village of Zuñi in New Mexico. This mesa rises about 1,000 feet above the valley of the Zuñi River and is very difficult of access. After the insurrection of 1680, when all the Spaniards in the country were killed or driven out, the Zuñis abandoned their villages in the valley and for over twenty years lived on the summit of Thunder Mountain. About the year 1700 they came down and commenced the building of their present houses.

The mesas are everywhere cut and seamed by cañons, sometimes mere gorges, sometimes interspaces ten or even twenty miles wide. The cañon walls are usually composed of cliffs of vertical rock, 10, 20, or 100 feet high, connected by long slopes of débris composed of fragments split off from the vertical faces. The bottoms of the cañons, as a rule, are flat and composed of rich alluvial earth brought down from above by floods. It is in these cañon walls that the cliff ruins occur, and they were always located so as to overlook some area of good bottom land which was under cultivation.

The edges of the mesas, like the walls of the cañons, furnish an inexhaustible supply of building stone, often of the proper form and size for masonry and requiring no dressing or other preparation. The sandstones of this region are strongly laminated and readily break up into flakes and tablets of almost any size desired. Hence building stone is abundant everywhere throughout the region, and

it required, as a rule, less work to build a house in the cliffs than in other places.

The unit of Pueblo architecture is the single cell, and there is no doubt that in early days each family built its home wherever it was most convenient. Eventually, however, it was found necessary to combine these little settlements into larger ones, on account of the depredations of surrounding wild tribes, who found in the Pueblo villages convenient store-houses of food. These large villages were usually located in broad, open valleys, as are most of the Rio Grande villages to-day, but the largest clusters are merely aggregations of many single cells.

The pueblo country is in the arid region, and aside from the river valleys cultivable areas are small in size and few and far between. Hence it has come about that many of the people have been compelled to go far from home to work their little farms. As the aggregation of many small settlements into one large village marks a comparatively late stage in pueblo growth, the custom of going away from home during the farming season was more prevalent in the past than it is now, but it is still practised.

The Pueblo Indians are an agricultural people, and have always derived their principal subsistence from the cultivation of the soil. They do so now as much as ever, and the Pueblo of Zuñi, the largest of the villages, has no less than three subordinate settlements, established for convenience of farming lands in the vicinity. Some of these are fifteen miles from the home village, and to go back and forth daily would be impracticable. Hence farming shelters are put up convenient to the fields, and are inhabited only during the season; after the harvest, the people return to the home village. Among the Moki Indians of Arizona, whose cultivated fields are in broad valleys some distance from the mesas where the home villages are, and where building stone is difficult to procure, it is customary to erect a rude platform of logs, with a screen of boughs on the windward side. This meets the two requirements—outlook over the fields and a place to live and sleep. Where building material is more abundant, these shelters take the form of regular houses. Sometimes the houses are in clusters, sometimes they stand alone; it depends on the extent of cultivable ground overlooked by them. But their use is always the same; they are occupied during the season, and after the harvest the people go back to the home village.

That the same practice prevailed in ancient times is evidenced by the ruins of thousands of single rooms which are found throughout the ancient pueblo country. In fact, it might almost be said

that wherever there is a little area of good land the remains of a house or of a small cluster may be looked for, and somewhere in the vicinity the home village will be found. Often the little outlooks were perched on high rocks, or even on large boulders. From these farming outlooks it is but a step to the cliff ruins, most of which are single rooms, or small clusters of rooms located in the cliffs, because only from such places could an outlook be had over the cañon bottom below. Nine-tenths of the cliff ruins are of this type, and the home villages to which they are related are to be found not far away. Not infrequently it happened that the site was occupied without the erection of any building upon it. The general character of the sites occupied by these outlooks is always the same: slopes of broken rock and débris extend up to them, and access is generally easy, if the explorer is familiar with cliff ruins and knows where to look for the trail. The ruins are nearly always located on narrow ledges in the cliff, and sometimes can be reached only by ascending the ledge at some point below or above. Of many hundreds of ruins that I have examined I can recall only two or three which could not be reached without the aid of other appliances than my hands and feet; and there is a fair presumption that the cliff dwellers themselves, accustomed from their earliest childhood to climbing about the cliffs, did not regard their homes as especially difficult of access.

The largest group of cliff ruins so far known was found in Cañon De Chelly, in north-eastern Arizona. Although situated in the heart of the Navajo Reservation, difficult to reach, and therefore seldom visited by whites, the cañon has been accurately mapped and parts of several years have been devoted to the study of the ruins. There are 140 of these ruins in the cañon and its branches.

De Chelly proper is about 20 miles long, with a general east and west trend, and lies on the western flank of the Tunicha Mountains. Its principal tributary, known as Del Muerto, is about 15 miles long, and comes in from the north. With all its turns and including all its branches the cañon is about 80 miles long, but most of the ruins are found in the middle parts of De Chelly and Del Muerto. At its mouth, the only place throughout its length where a wagon can enter, the walls of the cañon are but twenty feet high, and five hundred feet apart. The bottom is composed of a smooth stretch of white sand, into which the vertical walls are merged without any talus or intervening slope. In this part of the cañon there are no ruins. A little further up the talus begins, and with it many small areas of fine bottom land, formed of rich alluvial soil,

are found. Here the ruins begin, and they are invariably located so as to command an outlook over some bit of good land. Still further up the bottom lands attain their greatest development, and the ruins also are most abundant. At ten or eleven miles above the mouth of the cañon the talus begins to encroach on the bottom lands; here it consists of smooth sloping rock, either bare or but slightly covered with débris. Beyond this point the ruins become less abundant, and, as the talus finally blots out the bottom lands, meeting in the centre to form a narrow gorge, the ruins disappear. The cliff walls are not continuous, but run in and out, forming sharp promontories and deep coves, the latter sometimes running backward into little branch cañons a mile or more in length. In these places, where the bottom is flat, there are ruins; where the talus meets in the centre there are none. The little stream which meanders through the cañon carries water only during part of the year, but now and then, when in flood, it becomes a raging torrent impassable to man or beast. Ordinarily the only way in which one can procure enough water to drink is by digging a deep hole in the sandy bed of the stream and thus catch a little of the sub-surface drainage.

The walls of De Chelly are composed of brilliant red sandstone, discolored in places and streaked with black and grey. They increase in height gradually as the cañon is ascended, and a few miles above its mouth are over a thousand feet high. The region outside the cañon is densely wooded, but the height of the cliff is so great that the trees along the edges can hardly be seen. In the upper parts of the cañon, however, there are a few trees in the foothills and on the bottoms, and these form a pleasant contrast with the highly colored sandstone of the cliffs. The sandstone is soft and has been eroded by the winds and flying sand into grotesque and sometimes beautiful forms. In places great blocks have been split off by the action of frost, and the débris has sunk in the sand or been carried away by the stream, leaving huge walls 500 feet or more in height and width, smoother than any masonry could be. In such places ruins are never found, but localities where there was both an extensive outlook and easy access were favorites of the old builders. The bottom lands are old alluvial terraces, ten to twenty feet above the stream and now beyond the reach of high water.

The cliff dwellers in the Cañon De Chelly, like the Pueblo Indians of to-day, were a very religious people. Among the latter this feeling finds vent in the sacred dances which solemnize all the important events of the Indian year. The dances are often dramatic

representations of mythologic events, or a form of prayer for favors sought, or perhaps of thanksgiving for favors received. They are of frequent occurrence during the season when the men are not at work in the fields. Perhaps the most striking of these ceremonies is the snake dance of the Mokis of Arizona, which is in effect an invocation to the rain god to send showers of rain to his suffering children. In one of the figures of the dance snakes dropped from the mouths of some of the dancers are picked up by others charged with that special duty. Finally, when the stock of serpents is exhausted, all those which have been picked up are thrown into a heap on the ground. Then all the dancers scramble for them, and each seizing as many as he can, runs off at full speed to release them on all the trails leading out of the village. The idea is that they will seek the rain god, whose form is that of a gigantic serpent, and tell him what is wanted.

Many such ceremonials as this must be performed every year, but the rites which take place in public are usually the culmination of a long series. In the snake dance, for example, there are eight days of preliminary ceremonies; these take place in sacred underground or partly underground chambers known as kivas or estufas. Access to these chambers is always by a ladder through a trap-door in the roof, and no exterior openings of any kind are permitted. The kivas are usually put outside of the village or in an interior court. In these chambers all the religious and civil business of the tribe is transacted, and they are clearly the most important structures in the village. Some of the larger villages have twenty or more, others have only one or two.

The significant point is that in the summer settlements, designed for use during only part of the year, no kivas are ever found, for all the important ceremonies take place in the home village, most of them between harvest and planting time. In this feature, then, we have an excellent criterion of the character of a village ruin, and the application is made easy by the fact that in the principal cliff ruin groups, as in some of the pueblos, the kivas are circular in form, and can be distinguished without difficulty. A fine example of this circular form of kiva was found in a large ruin in Cañon Del Muerto. It consists of a round shaft some twenty feet in diameter, sunk about six feet into the ground, lined with masonry and smoothly plastered. There are many examples among the ruins, and it may be assumed that wherever the remains of a kiva are found the settlement was a home village, and where there was no kiva the settlement was occupied but a part of the year, for

certain ceremonies must be performed and to do this a kiva must be provided.

If we apply this rule to the ruins in Cañon De Chelly we find that perhaps nine-tenths of them were farming outlooks, occupied but a part of the year. But the home villages with which they were connected were not far away. There are numerous remains on the cañon bottom, usually at the foot of a cliff, but of such easy access that a wagon could be driven into most of them. One of the largest ruins in the cañon is called by the Navajos Pakashi-izini, from a pictograph of a cow on the cliff wall. Some of the walls are still standing to a height of three stories. The ground plan shows the remains of fifty-five rooms and of three circular kivas. There were altogether about ninety rooms, and the ruins cover an area 400 feet long by 40 feet wide; the population was probably about twelve families. In other words, the largest ruin in the cañon had only a small population, and as each family doubtless had some farming outlook in the vicinity, it is not necessary to assume a large number of inhabitants to account for the ruins in Cañon De Chelly. Many of the ruins of this class are quite small, and some of them could hardly have given shelter to more than two families. Only a bit of standing wall remains here and there, but no matter how small they may be they invariably show traces of one or more kivas.

One of the most interesting ruins in De Chelly is known as the Casa Blanca, or White House. This is the ruin which was described by Simpson in 1850. Part of it is on the cañon bottom and part in a cove some 35 feet above. Above the ruin the cliff extends 500 or 600 feet and overhangs about 120 feet, so that the dwellers were well protected from the weather. Although the upper ruin is now very difficult of access, there are marks upon the vertical wall which prove that at one time there was a continuous series of rooms rising from the ground to within four feet of the ledge, and access to the upper part was almost as easy as to the lower. The ground plan of the ruin is of especial interest for it demonstrates that not all of the ruin was built at one time. The kiva in the centre and the heavy walls to the right are of masonry, while the thinner walls in front of the kiva were made of adobe mud. As there is more than a presumption that adobe was not used for construction prior to the Spanish Conquest, its presence here is significant. Moreover, there is evidence in the plan that the use of adobe came at a late period in the occupancy of the site. The Navajos have a tradition that a Spanish monk was stationed here.

The same tradition attaches to the ruin called Mummy Cave, one of the largest in Cañon Del Muerto. The ruin consists of three parts: a large cove on the right, a smaller one on the left and an intermediate bench, almost completely occupied by heavy walls. At one end of the bench the walls still stand, in tower-like form, to a height of three stories, and retain their roof intact. The ground plan shows fifty-five rooms, together with three kivas; all of the latter are in the larger cove. There may have been altogether ninety rooms, but as many of them could have been used only for storage, the total population could hardly have been more than sixty persons. The intermediate ledge, which is 110 feet long and 30 feet wide, was covered by seven rooms, all of exceptionally large size and with walls over two feet thick. A large boulder on the ledge was not removed, but instead the walls were carried directly over it.

The right-hand or larger cove is 200 feet across and about 100 feet deep. The ruins occur along a narrow ledge at the back of it. There are remains of three kivas here, perhaps four, and one of them, in the centre, still shows part of a second-story wall. The left-hand cove is much smaller than the other and could be reached only from it, over the intermediate ledge. There were no kivas here and no place for one, and this fact suggests an interesting speculation: if a mission existed here some time in the 17th century, as the Navajo traditions aver and as evidence in the ruin suggests, the monks undoubtedly occupied the central ledge, where the very large rooms with heavy walls occur. This much being granted, it seems plain that the small western cove was used by the converts, and in this arrangement there is a suggestion that the Christian cliff-dweller, like the early converts in other lands, was made to lead a hard life by the unbelievers. It is known that several of the Pueblo villages in the west were completely destroyed because they were supposed to favor the new religion.

Mummy Cave ruin commands a fine outlook over the cañon bottom; in fact, extensive outlook was always a *desideratum* with the cliff-dwellers as with those of the tribe who dwelt in other localities. A typical example of the latter class is a ruin opposite old Camp Verde in Arizona. It occupied the point of a hill, and commanded a view of many miles up and down the Verde River.

Near by is the celebrated cliff ruin which is known as Montezuma Castle. It is near the mouth of a little flat-bottomed cañon through which Beaver Creek flows to join the Verde, and is near the top of the cliff. It is now accessible only by the aid of

ladders, and commands an extensive view over the bottom-lands. A ruin occupying a somewhat similar site, but in a much higher cliff, occurs in Cañon De Chelly. The ground plan shows sixteen rooms and two circular kivas, but although the ruin is eighty feet vertically above the bed of the stream, access is only a matter of agility. The rock is cross-bedded and has weathered into little ledges, inclined at an angle of 45 degrees and an inch or two wide. With proper care a man can easily walk up these inclined planes. This ruin contains the only structure so far seen by me which could be properly classed as a reservoir. It is on the extreme end of the ledge farthest from the ruins, and is so situated that it is directly above the stream, yet the sun shines upon it only for an hour or two each day. On the cliff back of it there are numerous paintings of tadpoles and other water emblems in common use among the Pueblos.

The irregularities in the ground plans of ruins are due to a peculiar cause. Fronts of adjoining or connected houses are seldom on a line; in fact, the contrary is the rule. The front line is always broken by jogs and offsets, not only in the first story, but in the upper ones as well. The same variety prevails in finish. Some houses are smoothly plastered, others are left rough. One house will be three stories high, while the adjoining one will be two stories or perhaps one. In Zuñi the same conditions prevail; in fact, they extend through the whole system of Pueblo architecture, for they grow directly from a long-established social custom. Among all the Pueblo Indians descent and inheritance are in the female line only. The children belong to the mother and are members of her clan. The father has no rights over them; in fact, his own standing is merely that of an honored guest, for when he marries he goes to the house of his wife's people and becomes a member of her family. If he does not behave himself he can be sent home.

It follows that a family in which there are many girls must grow, while that in which there are only sons must become extinct. As the girls marry and the family increases more room is required, but by a rule many centuries old, the new rooms must be built adjoining and connected with those already occupied by that family. Thus building is always going on, new houses are being erected, while old ones, perhaps only a few steps away, are going to decay. The building of a house is partly ceremonial and is always done by women, although rock, roof beams, and such heavy material is provided for them.

The irregularities in ground plan, therefore, are not due to mere lack of skill, but have a certain significance. Knowing a little of the conditions which prevail now and of the way in which they affect the ground plan, we can infer something of the conditions under which the ground plans of old ruins were produced. We can read in them the story of long periods of time when girls were given in marriage, when the village grew, and peace and plenty prevailed in the land. We can also see the times when dangers and trouble prevented the addition of new rooms, when old rooms were divided instead of new ones built, when the village grew more and more compact, less and less comfortable. From the plans also we can estimate how long the site was occupied, but we cannot as yet set dates for the beginning and end of that occupancy, except in a few cases.

The Navajos, who farm the bottom lands of De Chelly, usually store the products near the fields until such time as they are needed. For this purpose they build cists, which are filled up with corn and other grain and carefully concealed. The cliff dwellers followed the same practice, and hundreds of their old storage cists are to be found throughout the cañons. Sometimes the cists approach the dwellings in size, and it is not unlikely that many of the cliff outlooks were used for storage at times when they were not occupied. In the Navajo mind the cliff dwellings are tabooed, and under no circumstances will a Navajo make excavations in a ruin. They taboo their own dead, and something of their disposition not to touch anything from the ruins may arise from the fact that for many years their dead have been buried there. Their burial cists are small dome-shaped structures of masonry, flimsy in construction, but closed all round except a small square hole, which is always left in the top for the free egress and ingress of the spirit or ghost. Of the numerous human remains which have been taken from the cliff ruins, probably nine-tenths are of this class—that is, intrusive burials.

That the cliff dwellings were the direct result of a peculiar geographic environment is proved by the fact that marked changes in environment produce similar changes in the ruins. In the valley of the Rio Grande, the home of the Pueblos, there are no cliff dwellings, for the geologic formations there are not favorable to them. Similarly, in most of the valley of the Rio Verde, in Arizona, there are no cliff dwellings, but instead of them we have cavate lodges, as they have been called—actual caves excavated in the rock. They differ from cliff ruins in that they are artificial caves, whereas, in

the cliff ruins no excavation of the rock is ever made. In the latter houses are built in shallow coves, but as a rule houses exactly like them might as well be built in the open country. In the cavate lodges there is no construction, except, perhaps, about the doorway. A small doorway gives entrance to a narrow passage, perhaps six feet long, and this in turn to the main chamber, rudely circular in form, fifteen or twenty feet in diameter, and seven feet high. With this central chamber other smaller rooms communicate, sometimes as many as four in a series extending back fifty feet into the rock. But in all examples which have been found the rock is so soft that it almost crumbles in the hand. It is easily worked without tools, and less labor was required to excavate the lodges than would be necessary to build the same number of rooms on a ledge of the cliff.

Cavate lodges have been found only in four localities,—on the Verde, in the San Francisco Mountains of Arizona, on the San Juan, and on the Rio Grande. In all cases they occur in a material resembling volcanic ash, and are merely a variant of the cliff dwellings, due to peculiar geographic or geologic conditions. The doorways were made as small as possible, for there was no way of closing the opening in bad weather other than by hanging a blanket over it. It was made larger in the upper part than in the lower in order to facilitate the passage of a man loaded with a back load of wood or other bulky material. The same purpose was served in some of the cliff dwellings by T-shaped doorways.

In conclusion, a few remarks on the probable development of Pueblo architecture may not be amiss. There is little doubt that Pueblo architecture developed in the country where it is now found, for the almost complete adaptation to environment which is exhibited by it could come only from local origin. Had it been developed elsewhere and brought into the Pueblo country it would surely contain some evidence of its previous existence. Such evidence is always to be found in a transplanted art, and, above all, in a transplanted system of architecture, where forms, for example, derived from wooden construction are later embodied in stone.

In Pueblo architecture there is but one such survival, but that one is especially significant. The preservation of kivas of circular form, used in conjunction with rectangular rooms, has been accomplished at a great cost of convenience. That it was accomplished shows how strong a hold conservatism in matters religious has upon the human mind, for it is undoubtedly a survival from the time when the people lived in circular lodges like the Navajos

of to-day. Many of the rites and sacred ceremonies came down unchanged from that time, and they could be properly performed only in a circular chamber.

Another point which should be emphasized is that the unit of Pueblo architecture is always the single cell. The largest clusters in the valleys were merely aggregations of such cells, and the most difficult sites among the cliffs could not affect them. While differentiation in function had taken place as much in the cliff ruins as in the large valley pueblos, differentiation in form had not yet begun. Except in the doubtful examples in Mummy Cave ruin, which are possibly of Spanish origin, the individual rooms are practically of the same size and form throughout.

The cliff ruins are not an early, nor in fact any, stage in Pueblo architecture. They had their origin in that geographical peculiarity of the country whereby areas of good land are of small size and widely scattered, and in the habits of the people, who were essentially farmers and dependent on the products of the soil for subsistence. They belong as much to the latest as to the early forms of Pueblo villages, if not more, and in themselves exhibit a long sequence in time, but not in development. They are not a type, but a sub-type, pertaining to various other types of villages. They are exceptional only in the sites they occupy, and these sites are merely the product of a peculiar topography.

The cliff outlooks in Cañon De Chelly and other regions, the cavate lodges of New Mexico and Arizona, the watch towers of the Zuñi country and of the San Juan, the single-room remains found everywhere throughout the region, even the brush shelters of Moki, are all functionally the same, differing in form only because of a varying geographic environment.

# RECENT ADVANCES IN GEOGRAPHIC KNOWLEDGE

## Accomplished by the United States Hydrographic Office at Washington.

BY

G. W. LITTLEHALES.

The efforts of the Hydrographic Office of the Navy Department in the field of geography must be primarily to help the navigator. Working as it does in the interests of the marine of the United States and of those classes of our citizens whose interests are promoted by every advance in the safety and celerity of navigation, the production of good navigational charts and the deduction of the best routes to be followed by steam and by sail have constituted the principal aim. In pursuing this aim the domains of the geography of the land, the geography of the sea, and the geography of the air have been entered.

The most recent of the expeditions sent out by the Hydrographic Office for the telegraphic determination of longitude returned to the United States in 1890, after having determined the longitudes of seven of the important secondary meridians of Mexico, Central America, the West Indies, and the north coast of South America. There have been directly determined by these various expeditions about forty secondary meridians, by which the longitudes of the principal maritime and geographical centres of the Western Hemisphere and of China and the East are accurately related to the established meridians of the United States and Europe. Many more positions depend upon these, so that they may be said to have made a large addition to our accurate knowledge of the earth's surface.

The vessels engaged in maritime surveying have, since 1885, extended the Pacific coast work of the Coast and Geodetic Survey, as far as it relates to the construction of nautical charts, from the boundary line between the United States and Mexico southward along the entire western coast of Lower California and northward along its eastern coast to La Paz—a distance of more than 1,000 miles.

The officers of the U. S. S. *Michigan* on the Great Lakes have surveyed the western part of Lake Erie, the Detroit River, and the harbors of Chicago, Cleveland and Erie, and furnished data for representing upon the charts many rocks and shoals, which the

increasing number of deep-draft vessels yearly discloses in these waters.

The officers of many of the United States vessels engaged in the general naval service have contributed surveys and geographical information relating to the places visited by them. In this way great improvements have recently been made in our charts of the harbors of Colon and Panama at the Atlantic and Pacific termini of the Panama Canal route, of Greytown and Brito at the Atlantic and Pacific termini of the Nicaragua Canal route, of the principal commercial ports of Honduras and Guatemala, of Honolulu and Pearl River in the Hawaiian Republic, and of other ports and special localities in various parts of the world.

In 1889 there was an important accession to our knowledge of the Arctic regions through the cruise of the U. S. S. *Thetis*, along the entire main coast line of Alaska from Port Tongass, in extreme southeastern Alaska, to Demarcation Point, in the Arctic Ocean. The cruise of this vessel was remarkable in several respects. By successful battling with the ice-pack, she was enabled to reach Mackenzie Bay, in British North America—the first Government vessel to carry the American flag in these waters. She also made the long stretch from Mackenzie Bay to Herald Island and Wrangel Land in one season, which was never before done.

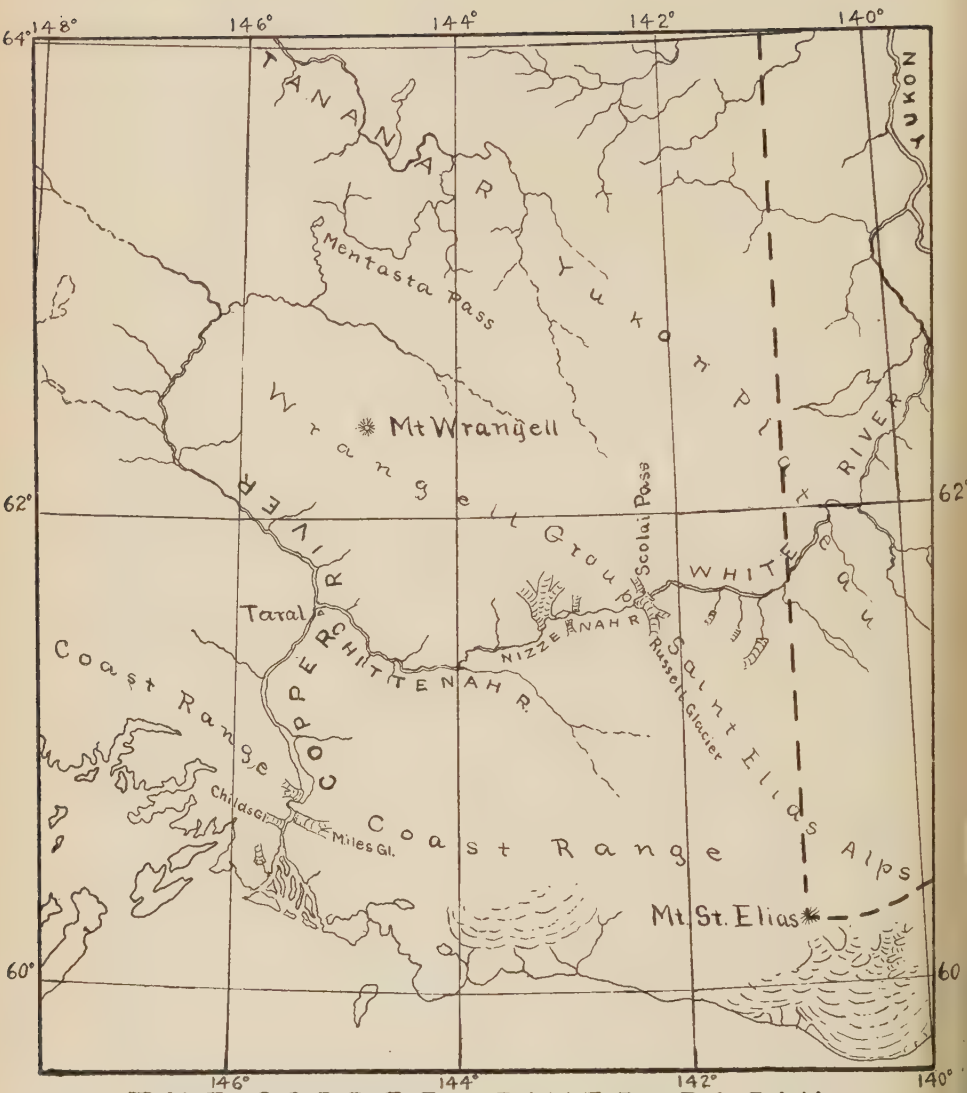
Drawing upon the common stock of geographic knowledge and upon the geographic information which thus comes into the custody of the Navy Department, during the last decade, a set of general coast charts of the Western Hemisphere has been constructed; sets of special coast charts, harbor charts, and special charts have been completed to the extent of four-fifths; and the work has been extended into the Eastern Hemisphere where the general coast charts of China and Japan are practically complete, and where work is in progress in reference to the general coast charts of southern and eastern Africa.

The observations made in recent years to determine the magnetic declination, inclination, and intensity in connection with the surveys carried on under the authority of the Navy Department and in the navigation of the vessels of the Navy, have been discussed with a view of assigning the correct direction of the magnetic meridian on the charts, and also to throw light upon the causes and character of the secular variation of the magnetic needle. The publication of these observations and results forms an important contribution to the science of terrestrial magnetism.

Toward the increase of our knowledge of the geography of the

sea, besides a specially planned survey carried on in 1892 to determine a practicable route for laying a submarine telegraphic cable between California and the Hawaiian Islands, many deep-sea soundings and observations of density and temperature have been made by the naval service in the waters of all the great oceans. These observations have been of service in providing for the expanding system of submarine cables and also in the problems relating to ocean physics; for which latter purpose, especially in their bearing upon ocean currents, the reports of incoming navigators have been carefully collected and studied. Knowledge of the tides has been improved in relation to certain localities where data have been observed; and at Chemulpho, in Korea, and Magdalena Bay, in Mexico, series of observations of sufficient extent have been made to warrant their investigation by the harmonic analysis. The resulting tidal constants for these stations have been published for the benefit of those who are engaged in the prediction of tides.

From the information extracted from the log books of vessels voyaging in all parts of the world, monthly normal isobarometric and isothermal values have been deduced for some parts of the great oceans, notably the North Atlantic and North Pacific. The charts of these lines show the average distribution of the quantity of matter in the earth's atmosphere, which is identical with the distribution of barometric pressure, and depends solely upon the distribution of temperature over the surface of the globe. If the monthly average directions of the winds and currents, which have recently been much improved by our latest deductions, are also delineated upon such a chart, the direct relationship between pressure, wind, and current, now completely established by meteorologists, will be readily apparent. Besides these results in the climatology of the sea, the regular observations of mariners have provided for some progress in dynamic meteorology. Daily synoptic charts of the North Atlantic and North Pacific oceans, showing the prevailing weather and the progress of storms that cross those regions, have been prepared for several years past; and there are published each month pilot charts of the North Atlantic and North Pacific oceans, showing graphically the matters of value and interest to the maritime community, and particularly the directions and forces of the winds to be expected during the month succeeding the date of issue, the set of currents, the feeding grounds of marine animals, the regions of storm, fog and ice, the positions of derelicts and floating obstructions to navigation, and the best routes to be followed by steam and by sail.




THE COPPER RIVER BASIN

Scale 0 20 40 60 80 Stat. Miles.

# COPPER RIVER AS A ROUTE TO THE YUKON BASIN.

BY

C. WILLARD HAYES.

The experiences of the past season on the lower Yukon and the trails leading into the interior from the head of Lynn Canal have shown conclusively that the present means of access to the Yukon basin are wholly inadequate to the demands already made upon them. The demands of the near future will be vastly greater, and much attention is being directed to the possibilities of routes with reference to the construction of wagon and rail roads. From an inspection of the map of North America the Copper River appears to offer a direct and easy route, and numerous accounts of projects for utilizing it have been published in the newspapers. In view of the serious results which are liable to follow mistaken ideas as to the character of the river and the passes leading from its headwaters to tributaries of the Yukon, it seems desirable that all available information concerning it should be made public.

The Copper River was ascended by the Russian trader, Seréberinikoff, in 1847, to a point about 60 miles above Taral, where he was murdered by the natives, but his notes were brought back to the coast, and, although meagre, they for many years formed the only source of authentic information on the region. In 1884 a party under Lieutenant Abercrombie was sent out by General Miles, then commanding the department, to explore the river. He succeeded in ascending only a few miles above the head of the delta, and was turned back by the lateness of the season and the obstacles which he met there.

The following year a party was organized under the command of Lieutenant Allen. On account of the difficulties of ascending the river by boat, which Abercrombie had encountered, he determined to go up before the ice went out of the river, carrying his outfit on sledges. Owing to various causes his departure from the coast was delayed until the snow and ice had become soft, so that he encountered severe hardships on the journey, but by almost superhuman efforts was able to reach Taral before the ice on the river became entirely impassable.

From Taral he went eastward up the Chittenah, the east branch of the Copper River, for about 75 miles. He there found Nicolai,

the chief of the Copper River Indians, and, obtaining from him a crudely built boat, he descended the east fork, and continued his journey up the main Copper River to the Mentasta pass, by which he crossed the divide to the Tanana. The account of this remarkable trip of Lieutenant Allen, published in 1887, contains practically all the available information concerning Copper River. Inasmuch as he traversed the lower part of the river, where the most serious obstacles to navigation occur, before the ice was out and while the country was still covered with snow, he was unable to obtain much information as to the practicability of its navigation. Since Lieut. Allen's explorations, the river has been ascended varying distances by an occasional prospector or trader, but no record has ever been published of their experiences or observations.

The problem of utilizing the Copper River as a route to the Yukon basin may be divided into a consideration of the river itself and the Mentasta and Scolai passes leading from its headwaters to the interior drainage. The passes will be considered first.

Mentasta pass has been described by Lieut. Allen. It lies almost due north of Mount Wrangell and leads from the upper part of the main Copper River valley to the headwaters of the Tanana. This region forms a part of the great Yukon plateau, the altitude of which is here between 4,000 and 5,000 ft. It is an undulating upland, above which rise numerous hills and short mountain ranges, though none of the latter carry snow throughout the year. It is sparsely wooded and dotted with innumerable small lakes. This pass, therefore, presents few difficulties to the construction of trails or wagon roads, or even to the building of a railway. It leads, however, only to the Tanana, a river so obstructed by cañons and rapids that its navigation is wholly out of the question, and a route through this pass would have to cross the Tanana and be continued all the way to the Yukon.

Scolai pass is much the more direct route from the coast to the Yukon. It leads from the head of the Nizzenah, an eastern tributary of the Copper River, to the head of White River. Its altitude is about 5,000 ft., or less than 1,000 ft. above the upper White River basin. Unlike the Mentasta pass, it is a deep narrow cut through a lofty mountain range. Much of its northwestern wall is precipitous, the cliffs rising almost vertically from 2,000 to 5,000 ft. From the southeast the magnificent Russell glacier flows down into the pass, and, striking the opposite wall, sends a lobe towards the northeast, from which the White River takes its rise, and another towards the southwest, feeding the Nizzenah. The latter stream continues

for a distance of 50 miles from its source through a deep narrow valley, which is simply a continuation of the pass itself. The high mountains on either side discharge large glaciers into the valley, the ice at one point damming the river and forming a considerable lake. It will be readily seen that this pass, although low and direct, is entirely impracticable for pack animals or as railroad route. Indeed, it is used by the natives only in the winter, when the rivers are frozen and they can travel on snow-shoes, since the steep slopes are covered with a growth of spruce and alder almost impenetrable.

Copper River receives many tributaries above Taral, but is chiefly formed by the confluence of two main branches about 50 miles northwest of Mt. Wrangell. From this point it is a river of considerable size, but rarely flowing in a single channel. It is generally bordered by gravel terraces, 100 to 200 feet in height, between which the river meanders, with a densely timbered flood plain several miles broad. Its channel is interrupted by innumerable islands and bars; the current is swift, and the water is seldom more than a few feet in depth.

The Chittenah River has essentially the same character as this upper portion of the Copper River. In fact, the Chittenah and the first hundred miles of Copper River, above Taral, occupy the axis of the same orographic depression, a broad valley lying between divergent mountain ranges, the coast on the south and the Wrangell group with the connecting spur of the St. Elias Alps on the north. The volume of the Chittenah is nearly equal that of the Copper at their confluence. Although the former has much the smaller drainage basin, it lies partly within the coast belt of heavy precipitation, while the upper portion of the Copper basin lies in the region of scanty rainfall to the north of the Wrangell group. Copper River might probably be navigated by a light steamer about 150 miles above Taral and the Chittenah about half that distance. There are no rapids or rocky obstructions, and the difficulties encountered would be only such as are connected with the navigation of shallow, rapid streams carrying great quantities of coarse sediment. Immediately below Taral the river is contracted greatly and enters a narrow cañon, with abrupt walls 100 feet or more in height. This cañon is something less than a mile in length, and would probably present no serious obstacle to navigation. The current is rapid, but the channel is deep, and there are no obstructions which prevent the descent with a canoe. The difficulty of ascending would be much greater for a small boat, but a steamer of

moderate power would doubtless be able to make the ascent in perfect safety.

Below the cañon the river again spreads out and forms a large number of channels among sand bars and low gravel islands. No boat drawing less than 16 to 18 inches of water would find much difficulty in getting over these bars, as the current is not sufficiently strong to be a serious obstacle, and no bad rapids occur. This character of the river continues for about forty miles. The flood plain of the stream then gradually broadens and the current slackens, with a corresponding decrease in its carrying power and in the size of material deposited. The river here forms a delta in fact, filling a recently formed lake. This slack water extends for a distance of 15 miles. The lower portion is a broad and muddy flat, through which innumerable small streams meander. Beyond the mud flats the river expands into a small lake, the remnant of one originally much larger, but gradually filling up. Below the lake is found the obstruction to which it is due. (This portion of the river is shown on the large-scale sketch map accompanying.) The great excess of precipitation on the southern side of the coast range causes the snow line to approach much nearer sea-level there than in the interior. The lower limit of perpetual snow has a difference in altitude on the opposite sides of the range of something more than 4,000 feet, and this notwithstanding the fact that the mean annual temperature in the interior is many degrees lower than that along the coast. As a consequence of this rise in the snow-line and less abundant precipitation, the glaciers flowing from the northern portions of the range are insignificant compared with those which flow from the southern side. The mountains around Taral do not furnish any glaciers. Descending the river, a few small ones may be seen high up on the mountain sides, but none reach the river valley until near the coast. In descending the river the first one encountered which reaches the valley is a large double glacier coming in from the west. This has pushed its terminal moraine out into the expanded portion of the river, and forms an ice-cliff for a few hundred feet at its northern margin, as shown in the map. For the most part, however, the ice is separated from the river by a broad mud flat. A short distance below a much larger and more active glacier, named by Abercrombie after Gen. Miles, comes in from the east. Within comparatively recent times it doubtless extended entirely across the valley. It has brought down large quantities of rock, and while it had a much greater extension than at the present, its northern lateral moraine was built entirely across the valley.

The ice has since retreated, but this lateral moraine remains and forms the barrier to which the slack water is due. A smaller glacier comes in from the west directly opposite the Miles Glacier,


and the material which it has brought down has assisted in the formation of this dam. The river has been pushed to the extreme

western side of its valley, and for a distance of about two or three miles flows in a shallow cañon whose sides are made up in part of rock, but chiefly of coarse moraine material. The river channel is narrow and the current very rapid over a rough boulder bed. The amount of fall has not been determined, but it is probably between 50 and 100 feet. This was named Abercrombie Cañon by Lieutenant Allen.

From the lower end of the cañon a strong current enters another body of slack water and strikes against the ice-cliffs, which terminate the Miles Glacier. These ice-cliffs are between 200 and 300 feet in height, and are discharging bergs almost continuously. The lake in front of the glacier is filled with these bergs, and is frequently thrown into the most violent commotion by the fall of a large mass of ice. With a strong wind from the south, which is the prevailing direction in summer, the ice is driven into the northern end of the lake, forming a dense pack capable of grinding to pieces any boat which might get caught there. This, together with the current of the river, makes the passing of this lake extremely hazardous, and unless the conditions are favorable the Indians prefer a portage, not only across the moraine on the north, but across the three or four miles as well. It should be said that there is evidence of the rapid recession of the front of Miles Glacier, and this may have gone so far since 1891 as to greatly lessen the danger of passing it. Beyond the front of Miles Glacier the river bears toward the southwest, still with a slack current, and within a few miles strikes the front of the Childs Glacier, which enters the valley from the west.

This presents an ice-cliff to the river only along the northern part of its front, its southern portion descending to the river by a gradual slope. The strong current sweeping past its foot carries off the ice as fast as it falls, so that it does not accumulate as in front of the Miles Glacier, and consequently forms a less serious obstacle. It is not, however, entirely harmless, as a prospector reported that in passing it a large berg was discharged, and the consequent swell overturning his boat carried it far up on the opposite beach.

A short distance below the Childs Glacier the river expands and breaks up into a number of channels between bars of coarse gravel. This is the head of the Copper River delta, which extends for a distance of about 30 miles to deep water. The material deposited becomes rapidly finer, and the lower and more extensive portion consists of broad mud flats.

It appears that there would be no serious difficulty in finding a channel through the delta which could be navigated by light draft steamers.

From the foregoing it will be readily seen that the Copper River presents serious obstacles to navigation. The rapids of the Abercrombie Cañon are, perhaps, the most serious, and it will probably be found quite impossible to ascend them with any kind of a boat. A portage across the main dam of about 2½ miles will then be necessary, to the slack water above Abercrombie Cañon. From this point, 16 to 18 inches of water can be depended upon to the Taral Cañon. Here the current is swift, although the water is deep, so that a boat of considerable power will be required to make the ascent. From Taral northward on the main Copper River, or eastward on the Chittenah, navigation will be attended only by the obstacles everywhere encountered in streams having a rapid fall and overloaded with gravel.

The first, and up to the present time the only, information concerning the pass between the Copper and the White River basins was obtained by the 1891 Schwatka expedition, of which the writer was a member. Considerable information as to the possibility of navigating the Copper River from Taral to the coast, additional to that obtained by Abercrombie and Allen, was also obtained, and most of this has never been published.

The '91 expedition reached Ft. Selkirk, at the confluence of the Pelly and Lewes rivers, via the Taku River, Lake Ahklen, and the Teslin and Lewes rivers. At Ft. Selkirk we secured native packers, who professed to be familiar with the country, and agreed to go with us to the home of the Scolai, on the Copper River. We proceeded overland in a general southwesterly direction, parallel to the main axis of the White River basin, and crossing its numerous southern tributaries. When we reached the northern edge of the Coast, or St. Elias, range, the natives refused to accompany us further, and the party, Lieutenant Schwatka, Mark Russell and the writer, determined to continue alone. We followed the northern base of the St. Elias Mountains some distance westward, and finally discovered a low pass by which we reached the east branch of the Copper River, and thus made our way to the coast.

While the obstacles of navigation outlined above and the nature of the passes will doubtless prevent this from becoming a thoroughfare to the Yukon, the river must still form the chief means of access to a large territory, and one which probably needs only a thorough prospecting to reveal great mineral wealth. It certainly

contains copper, both native and in its various ores, possibly in large amount, and the indications that it contains gold are also good. If the difficulties to be encountered are foreseen and provided for in advance, there should be no great hardship in reaching any part of the Copper River basin.

Finally, a word as to the natives. Much has been said in the papers concerning their treachery and bloodthirstiness. They have had a bad name since the killing of Seréberinikoff, in 1847, but that worthy doubtless merited the fate which he met. The fact that the Indians themselves reported his death and returned his effects to the Russian post is much to their credit. So far as we could judge from ten days' intimate intercourse with them, they are thoroughly trustworthy and honest. They are very much superior to the Pelly and White River Indians in their physique, manner of living and moral standards. Nicolai, the chief of the Taral Indians, is a man of much force of character, and that he is a shrewd trader is nothing to his discredit. It is safe to say that any one going into this country will have nothing whatever to fear from these natives so long as he deals fairly by them. It may be said in their favor that they would probably resent any serious injustice or imposition upon their good nature.

C. Willard Hayes.

December, 1897.

# SOME OBSERVATIONS ON PRISONS IN VLADIVOSTOCK AND SAKHALIN.

AN ADDRESS BY

BENJAMIN HOWARD, M.A., M.D.

MR. PRESIDENT, LADIES AND GENTLEMEN:

I feel very grateful, naturally, for the very kind remarks by which I have been introduced to you. Allow me to say that coming from one whose apt eloquence on international occasions has won for him the admiration, the respect and the attention of geographers throughout Europe, and who has also commanded for every member of the American Geographical Society a certainty of cordial welcome on all international occasions, I am very grateful.

I see, by the card, that I am expected to deliver a *lecture* on the subject in question. To lessen your forthcoming disappointment I ask you to expect only a little talk from an old neighbor and friend, who, although he has visited Russia four times up to this moment, has never even sent a letter to a newspaper on this topic. So you will understand that this is purely a confidential talk to old friends and neighbors.

It is an extremely difficult thing for the people of any one country to form a fair judgment or estimate of other countries, and especially of the penal system of any country; that penal system having been evolved out of conditions of which you yourselves have no experience. Consequently, I have taken very great pains in my studies of penal questions first of all, as quickly as I could, to understand the people. In this way I have found what I think you will find, if you choose to prove it, that if you want to understand the genius of a people the place where you will learn it is rather in the prisons than in the palaces.

I will ask your attention to one preliminary remark.

In connection with what I have just now said about our forming a fair estimate of the penal system of another country, I would suggest that you try to remind yourselves of the nature of Russian civilization. It is most difficult, when we think for a moment of the present position of Russia among the nations, to imagine that only eight or nine centuries ago the Emperor of Russia was a heathen, notorious for his human sacrifices to his heathen gods. It is difficult for us to imagine that less than two hundred years ago

the very ground on which the Russian capital now stands did not belong to Russia.

Although we find most wonderful culture, intelligence and learning in Russia, and everybody who has met Russians has remarked their courtesy, their finish and their remarkably correct pronunciation of any language, still it is only fair to say that those individuals are much like the silver and gold that we find in silver and gold mines: it runs only in streaks and in pockets. For the rest of the people we will not say much.

One of the greatest difficulties in the way of progress in the Russian Empire was the nomadic habits of the people. As you know, they were mostly Tartars; those who were not Tartars were Goths. And during the early part of its history the entire area of Russia was so overrun by Tartar tribes that, like the waves of the sea tossing to and fro, army was marching against army, tribe against tribe, with inevitable bloodshed, and such famine as has never been heard of in history, out of China.

The first time there was any cessation of this bloody strife was when Ivan the Terrible managed to meet these Tartars with firearms. That gave them a shock from which they recoiled, and fled toward Siberia. The next step in the progress of Russia was when Boris Godunoff introduced by an edict the institution of serfdom on the 25th day of November, 1597. He issued an edict that every peasant should thereafter belong to the soil on which he was found on that date. Much as it may go against our general feeling to consider this idea of serfdom, undoubtedly it was one of the most important steps in the commencement of real progress in Russia.

Now, about this time Yermak discovered Siberia, and the great question became, "How to populate Siberia?", because that immense area was only a geographical expression. "How shall we colonize that country?" Emigrants could not be sent from Russia, the men being bound to the soil. They were serfs. That edict did not cross the Urals. There has never been a serf in all Siberia. From whence, then, should this population come? This problem confronted Peter the Great and he began to send his prisoners of war there, Swedish, Norwegian and others at first, and afterwards criminals were sent. One of the problems before the Government, and a great objective point to be attained, has been the productive, solid colonization of Siberia. Remembering this, it may be supposed that when a magistrate sends a man to Siberia he feels that he has done something for his country, knowing, as he does, that the very best land in the Russian Empire is that of the middle regions of Siberia. The exiles, none the less, try to escape.

Between 1871 and 1876, for example, from one province alone, over five thousand exiles escaped, or attempted to escape. It costs a good deal to send an exile to Siberia, and if you have then to hunt him up and put him back, it is a very costly matter, and there are, besides, the immense army and the posts needed on the border. The remedy that seemed to suggest itself for this great expense was to have some great out-of-door prison from which nobody could escape, and the Russians thought of Sakhalin, the island of which I am going to speak to you.

Although the old Tartar nomadic feeling is strong among the Russian masses, still they have a superstitious dread of distances. If you should go among a crowd at the piers of St. Petersburg you would not ask in reference to a stranger, "How much has he got?" but "How far?" Tell me how many versts a man has been condemned to, and I will tell you his crime; at least I will tell you the verdict. If it is a mild crime, it may be simply to Tomsk, for a year, or two or three years. If it is a worse crime it may be two or three thousand miles further. If more, still further. So it is continually going beyond, and beyond, and beyond. The part I will show is where we come to what may be called getting behind the *beyond.*

It is very common among my friends, to ask of me, "Now tell me, is it really all true, those horrible things that are told us about Siberia?" Well, now you see if I were to attempt to answer that, it would take me a hundred years to find out all about those horrible things, and I can't say "No" or "Yes," because it would take me just as long a time to become competent. The most I can say is "That it is possible." But I am quite at liberty, and that is what I am going to do to-night, to tell you some things I know. Not because I wish you to accept my view—I have no view—but because in this way I contribute a personal part; just as if you want a truthful picture of any one man it is better for you to have a great many, forming a composite picture, and as you gather experiences in that way, of a great number of people, without the trouble of going yourself, you may arrive at some tolerably fair conclusion. But you must not be surprised if nearly everybody gets a different impression wherever he goes, from that which he sees; the very best results to most of us in foreign travel anywhere are really subjective just as much as objective.

My attention had been called to Sakhalin and I was anxious to know whether there were any political exiles there; call them "reformers" if you like.

I saw an official letter, No. 2926, and it gave a long list of political exiles; and the letter stated that no distinction must be made between them and other convicts. That is precisely the most difficult and painful part of the political exile question. There is such an immense difference between the lower orders of Russia and any man of education, that that is frequently one of the most painful parts of the situation of the exiles. Instances were reported in a newspaper of merciless beatings and cannibalism, and I read the name of a certain official who would first starve and then shoot the convicts, and state that the deaths were through disease.

I thought that somebody ought to know about this place, and though it was said to be impossible to get there, I thought I would try it. Most writers on Siberia have stopped short of the Pacific. Kennan got as far as Irkutsk, and there turned back. Lansdell got as far as Yakutsk; he tried to go as far as he could.

Further east is Vladivostock, the terminus of the Trans-Siberian railroad; and beyond this lies Sakhalin, the place of which I speak. When it was first instituted the people sent there were murderers, double murderers, heads of gangs of assassins, and political culprits who were held to be of equal criminality. I had the good fortune to get there at a time when the population was simply at its worst. This island, you see, is about from 45 to 54 degrees north latitude, and is bisected by about the 142d degree of east longitude.

When I arrived at Vladivostock I at once called upon the Prefect, handed my card, showed my passport, etc., and the same evening, while I was at dinner, he was kind enough to come and join me. Well, he was amiable; I tried to make him so. He said he was very much astonished; he could not understand it. Whatever could I be doing; why should I come out all this distance?, etc. I gave a great many explanations, and he thought I must be an extremely rich man, and all that sort of thing, and then he said, as he was going away, "What can I do for you?" "Well," I said, "that's very kind of you. You can't do much for me." "Well," he said, "what would you like?" "Well," I said, "you see what I am after; I am trying to go and explore the Island of Yezo." (This is the most northern island of Japan.) "It seems to me that the only way, according to the map, is to strike Sakhalin, and then cross the strait of La Perouse, and land off Cape Soya; then on that very volcanic island, which so far as I know has not been traversed, I intend to travel from the north to Hakodate. If you can help me to Sakhalin——" "Oh, no. The fact is that it is a name; you know that there is a certain place which we don't mention very often, ex-

cept when we are very angry perhaps, and Sakhalin is just such a place. I have heard a convict say to another, who had been sent to Sakhalin, that he had gone to the Isle of the Damned."

He said, "Would you care to see the prison?" "Oh, I have no objection; yes, if you like." I never exhibited any special desire to see what I was there for. So at last I consented to go to the prison. It was like most of those prisons—a huge stockade, with a great, heavy log gate, on entering which you are surrounded on all sides by the big outer court, with *cameras* (sheds), you would call them barracks. Not much of the prison idea, such as we understand by "prison." In there and in the various cameras were two or three hundred men standing about. They were smoking, those who wanted to, and talking; if they wanted anything to eat which was not furnished by the authorities, anybody was allowed to give it to them from the outside, handing it through the gate. The most troublesome part, the worst part, is the absence of occupation.

The fact is that the larger number there were under arrest and had been awaiting trial, and that is one of the sad features in these prisons,—the long time before a man can get a trial. It all grows out of the passport question. Nearly everybody who was there was one who had some other man's passport, or who had none.

The Prefect said: "Now go, wherever you like; no hesitation. I will stand away; go off somewhere, talk to anybody, say what you like."

I went through the various cameras and then among the men. My friend said: "I'll tell you one thing in advance. You will find that the men have not done anything wrong, and they would like to know what they were there for." Well, I found that that statement was true. Then he said: "I will point out some men who talk French and German; perhaps that will be easier for you." He did so. I was talking to one man in French, and he told me a most sad story.

He had escaped, and was fifteen months going through the forests. At last he reached Vladivostock, and succeeded in what they like better than all. He succeeded in getting on an American ship, and he thought he was safe. He packed himself in amongst the cargo. The vessel was to sail in about three hours, and when three miles away of course he would have been free forever.

Suddenly he felt a tug at his right boot. He had not had the slightest idea of it, but his right foot was sticking out, and the man who was tugging at it was a policeman, making his final search of the ship before it sailed.

I went after that to the first village. It is up the road and around the hills about three miles. That is a village entirely for exiles, and as I like always on such occasions to go quite alone and drop in unexpectedly, I visited most of the cottages.

In Vladivostock I talked of nothing but the exploration of Yezo, and it got about in the Marine Club that I was some sort of a wonderful explorer. I could not help that. I did not call myself an explorer, but as an explorer they gave me a dinner at the Club, and there sitting nearly opposite me was a magnificent looking officer in full regimentals. I told him what I wished to do. He said: "But do you think you dare try?" I said, "I don't know; I have crossed the English Channel in an open rowboat, and I think I can visit La Perouse Strait."

He said nobody was allowed to go to Sakhalin. In the first place, there is no means of getting there, and then nobody would be allowed to land if he did get there, because the sentinels would stop him, and he must have a special passport from the Governor, and then if I did get ashore there is no such thing as a tavern or a bed or a store on the entire island. "What would you do?" I said, "I don't know what I would do, except that I had always found the Russians a very hospitable people," etc. Well, the dinner went on and he became wonderfully amiable, and insisted, as he had only finished his holiday (he had been away for a month), and was going back to-morrow or the next day, that I must go with him and stay with him all summer—as long as I liked. "To tell the truth, we are as badly off as the exiles themselves," said he. "There is very little difference between us, and if you will only come it will be a benefaction to us all. We shall all thank you for it."

If I had hesitated a moment the door would have been completely shut against me. The best things that come to the traveller are the unexpected, and if you wish to be successful as a traveller you must seize any opportunity which happens to turn up.

With true Russian punctuality, instead of starting to-morrow morning, he started the day after to-morrow morning.

It took us about three days and a half to reach Sakhalin. When we arrived I had a very beautiful experience. Just as we were approaching these straits, at dawn, I noticed an island which looked like a monument. It is about ten miles around, and from every side, in curves of the most beautiful description, it rises from the extreme base to the apex, not like a pyramid, but with a beautiful sweep of curves, six thousand feet. Under the morning

mists and then with the disappearance of the mists, and in the different atmospheres through the day, it was surprising how beautiful were the effects, and as sunset approached the mists around were deepening and the colors becoming more and more rosy and then gorgeously red. Just as the sun was going down the full moon came up. One side of this mountain was suffused with the rosy blush of the sunset, the other side colored with the white light of the moon, and as the sun went down and the moon rose up and up, the lights crossed and the flush cooled and then faded away until it seemed like a human blush, and then down and down, whiter and whiter as the moon rose, it came to be as white as snow.

My first revelation of the peculiarities of Sakhalin occurred the day after this. I was on deck and I said to the first mate, "What a remarkably good boatswain that is you have got. He seems to look so well after the men." He said, "Come here." I went with him to the other side of the deck. "Now," said he, "you must not tell anybody about this secret, but that man is a murderer; they are all murderers, but," he said, "a better man I don't wish to have. The other men know what sort of a man he is, and I assure you they know how to keep their places, and I have no trouble with any of them."

The Government boat was manned in that way, and then I saw the reason for what I had hardly noticed before, that the gangways were all guarded by sentinels.

Well, we arrived after three days and a half at Korsakoff.

The one thing that strikes you as you get further and further north in those regions is the silence and the absence of life. Here is a large bay, but it has not a sign of life. Here are buildings running up the hill to the top.

We landed, and just here the officers were awaiting us. The Governor invited several friends to come up to dinner. We had just had dinner on the boat, but that does not matter in Russia.

During the general talk among the officers, I noticed that there was a considerable sensation, and asked what had happened. "Well, only five of the worst men escaped last night, and it is impossible to know what road to travel, or what may happen."

The Governor's house was all of wooden logs, very thick—a house like a fort. A room, very large and comfortable, was the Governor's bureau, private room, etc., and was assigned to me. In one corner was a very suggestive thing, a table piled up with letters, loving messages from different parts of Russia, never delivered and messages also from here which had never been delivered. These

letters were being inspected, and nobody could tell which would be delivered and which not.

Well, these five men had escaped, and it was said their favorite revenge was fire, and that it was impossible to know what would happen.

When the Governor said "Good night," he brought pistols and laid them close beside me, and then a walking stick, made to look like an old-fashioned battle-axe, such as Ivan the Terrible had, and he set that down. "Now," he said, "it's all right." I did not say a word. He did not know that I knew of the escape, but he said "Don't hesitate. Au revoir," and went away.

I felt rather uncomfortable when he said that on no occasion was I to open one of the heavy barred windows. I said I would not. After awhile, I suppose about two o'clock in the morning, I heard *clank*, *clank*, outside. I must say I was very, very anxious indeed, but nothing happened and the next morning I was told that it was probably the guard. At day-break—you could hardly see day-break on account of the shutters—one of the ugliest looking women I ever saw crept in with a cup of tea that is always given in Asia very early in the morning;—and she was a *murderess*. I went to the little tent outside to have breakfast, and a man came up behind me and reached over my shoulder, and he was a murderer. Then when we rode out after breakfast, a man, with magnificent broad shoulders and splendid face, drove, and he was a murderer. The fact is, strange as it may seem, they have no choice; all the domestics must come from the material they have, and if you take a thief, he is almost always sure to stay a thief, while a murderer may be a very nice kind of a person. They did that kind of thing among themselves and I don't want any better men than some of those that were sent there for murder.

The Governor said, "Now then, I'll tell you what I propose to do. You see I am just back. Everything is out of order. Now it will take me a long time to catch up; I have got to inspect everything. We have got forty-four horses in the stable, a steam pinnace, launch boat, and we will have to inspect everything, and I want you to go with me if you have no objection." That was just what I wanted.

Well, it is a peculiar thing to be in a country under such circumstances. The silence, everywhere we went, for example, was a striking thing. There was not a bird except a throstle, and that had no song; there was not a flower that had any fragrance; there was not a fruit that had any sweetness.

The fish at Sakhalin were very remarkable. It may seem strange but it is true, that standing at the dock, it seems impossible to drop a stone without killing a large number, or dip a net without pulling it up full.

The prisoners serve two years in prison. The first question asked is, "What can you do?" and then the prisoner is put at anything he is best capable of doing—lodging in the prison.

If he is capable of work in the prison, it may be carpentry, etc.

At the end of his two years, or perhaps less, he is told he can go out and still work in the prison or otherwise, but he is helped until he can maintain himself.

If he is a farmer, and understands agriculture at all, he is sent out to one of the thirteen agricultural villages. He is given a new modern cottage, or an old one, and he is allowed a certain amount of money. He has an ox, and if he requires it, a horse, a team and all sorts of seed and rations to subsist on, until he can get his crop.

The essential idea is to direct the men into self-maintenance just as soon as possible.

The prison stands opposite the Governor's house.

You find a number of large yards, and these barracks or modern houses around each yard.

In all that large prison there were only three cells, all large rooms. The Russians are a gregarious people, flocking together. They do practically what they like in prison—they smoke and go out in gangs to work. The three cells I saw were occupied by the most distinguished prisoners, and it is considered a sort of a special favor to occupy them. Two of them were occupied by princes, and were fitted up about as well as the quarters of an ordinary captain.

I made my observatory of the hospital, because, as I have said before, in a prison you can study the genius of the people, but if you get into the hospital then you know that nothing goes on but what it comes to the hospital sooner or later, and if there has been any damage, whatever it may be, it has to come to the hospital; if it is disease from over-feeding, or under-feeding, or if a man has been flogged, it has to come to the hospital.

We made our inspection that day of the dog-house; they had hundreds of dogs, because in winter the only way of travelling is by dog sleds. They have to keep them of course, hundreds of them, all summer.

I have seen the prisoners going in gangs from the prison to their work, and they seemed fairly well off—tolerably well clothed. Outside of the coal mines they may be seen resting themselves.

The mines are not like English coal mines, which have very deep pits, but are all surface mines.

In and about the church, on Sunday mornings, there are groups of the free. No prisoner is allowed to go there. The priests told me that they never had anything to do with the people in the prison; which is a great, sad defect. Here it is just as in any village church, and the place is quite full. Inside the church you find the Governor and the military, all on a par, all kneeling together, except that for the ladies there is perhaps a strip of carpet (you know there is much genuflection in the Greek service), and it is a most interesting sight. In the Greek church a great deal of the service is done by laymen. The layman in this case, a capital reader, was a murderer. The choir also, splendid singers, were murderers.

One thing was very pathetic: almost every woman, and some of the men, had on something or other which, you could see, had been brought all those thousands of miles—something which belonged to and reminded them of the place from which they came; it might be a little handkerchief, a kerchief, a little ribbon—but something peculiar, and one who knew the provinces of Russia could always tell where the wearer came from.

After I had seen them worshipping so earnestly, I could not help it; I was one of them and we were all worshipping together, and I have not the slightest doubt, that whether they were murderers or not, if strangers could see such a congregation, they would ask themselves, as I asked, is it not better, would it not be better, that all these convicts should be worshipping together, than that they should have been hanged?

There is no provision for education; that is voluntary. The Governor's wife takes charge of the matter and the school is supported partly at her expense and partly by contribution from others. But I have never heard of much money being spent.

The commonest punishment of the criminal is to shave half his head and chain him to a wheelbarrow. It is a long chain and gives him plenty of tether, but he has got to take his barrow with him, or he cannot go at all.

Flogging by the knout has been prohibited in Siberia. It is allowed only on this island of Sakhalin, and for murder. No Russian civilian is allowed to witness an execution of that sort; certainly no traveller. You can look over any book you like, even any romance you like, and I think you will find that no author ventures to say that he himself saw a case of flogging.

Although the Governor and I were so intimate, I noticed for the

first time one day a little constraint in him. I met the doctor, and said, "You do not look very well." "Well," he said, "I am very unhappy. There is a case which has come into court for flogging for murder, and I don't like it."

It was not a thing that I would like to see, but I thought that somebody who was competent should know what this flogging by the knout was, and however painful it might be to myself I had better see it for the purpose of truth. I saw very well that the Governor was keeping something from me. Here comes the advantage of being a doctor. The prison doctor went to the Governor and said that the prisoner's case was so critical, that he could not take the responsibility of deciding whether he was fitted for the punishment, at the examination which must take place four hours before, and he asked that I might come in consultation with him. The Governor could not refuse, and I did it. I afterwards went and saw the flogging. It took place in the great yard of the prison, in the presence of the Governor, the surgeon and myself. The criminal was stretched out on a table in the middle of the yard, and behind him stood the executioner. To the right of the table and at a good distance was the man who kept the tally, and counted aloud each blow as it fell: one, two, three, and so to the end.

I have never seen anything which was so painful to witness. The knout has a large thick handle, the strands of the whip are divided into three by knots, and with a hard end, and the scourge descends like a bird of prey, and picks out the piece.

The only pleasant thing about it is the end. As soon as it was over, and the man was not dead, he was taken to the hospital, and the doctor, who was one of the best of men, cared for him just as much as if he had been a sick woman in New York.

Punishment of this kind is unusual. The result of my observations in Siberia and Sakhalin is this: However bad the whole system may be, the Russians have a genius for mild administration. You will see that all through there is one idea, colonization, the utilization of criminals and political exiles for the highest good of the state. I think that this is a lesson that we might learn in our own prisons.

After we left Sakhalin, we had a most wonderful display of phosphorescence. About midnight we were struck by a typhoon, and such was the light, as the waters rushed in upon us, that every flake of foam was like the striking of a match, and the splendour was so great that you could see every face the whole length of the deck, and the whole outline of the ship. It was like being in the midst

of fire. It was so magnificent that we seemed to be in another world.

Our ship went to pieces and we were five hours in the water. At last we got to an island where we built a raft, and were picked up by a vessel bound for Japan.

On the way we encountered another typhoon, the one in which the Turkish man-of-war *Ertogrul* went down with some 600 men, who had just received special signs of favor from the Emperor of Japan.

## WASHINGTON LETTER.

WASHINGTON, D. C., APRIL 15, 1898.

The principal topics which may be considered as of geographic interest in Washington have been, first, and primarily, the all-absorbing question of Cuban affairs. This has pushed into the background the otherwise weighty matter of surveys and explorations of Alaska—the land of ice and gold. The public, also, has almost lost sight of the controversy over the future of the forest reserves, and apparently is ignorant of the attempts being made by interested parties to secure the nullification of the President's proclamation.

CUBA.—The reports of the consular officers lately resident in Cuba have at last been made public in response to resolutions adopted by Congress. These papers, held back for State reasons, have been made accessible to all citizens, and the facts of the indescribable suffering and wholesale death by starvation are related in the pages usually devoted to statistics of trade or the condition of special industries. These reports embrace communications from consuls at Matanzas, Santiago de Cuba, Sagua la Grande and other points. The more startling or distressing facts contained in them have been by this time diffused through the public press and the estimates as to the enormous decrease in population through starvation and pestilence have been many times repeated.

The efforts of various departments of the Government at Washington to secure correct geographic information concerning the island have brought out strongly the general lack of precise information. It has been possible to compile maps covered with names, presumably those of settlements, and with a network of lines indicating means of communication, but as to whether these roads are passable even by means of pack animals is a matter concerning which there appears to be much doubt and uncertainty, and it seems highly probable, from the reports of persons who have recently penetrated the interior, that many of the places named have no local application, there being possibly no resident in the neighborhood.

SURVEYS OF ALASKA.—On April 5 the U. S. gunboat *Wheeling* left Seattle, Washington, carrying the surveying parties who will

begin the first systematic mapping of the interior of Alaska. It is proposed to inaugurate work similar to that which has been so successfully begun in various parts of the United States. Topographic maps will be prepared showing the absolute elevations by means of contour lines located at intervals of 100 or 200 feet vertically, and referred to sea-level or some datum point whose altitude will be ultimately ascertained. The scale of mapping will probably be 1 to 90,000, with the idea of final publication on a scale of 1 to 250,000, or about four miles to an inch. While the topographic mapping is being carried on a thorough study of the rock structure of the country will be made, and especial attention given to the mineral resources, particularly gold and coal.

The general direction of the field parties has been entrusted to Mr. George H. Eldridge, an experienced geologist. On reaching Alaska the parties will be separated, and, as necessitated by the nature of the work, will proceed to a certain extent independently, rendezvousing about September 15 at St. Michaels, in order to return to the United States. Besides Mr. Eldridge, the geologic field work will be carried on by Mr. Arthur Keith, Mr. J. Edward Spurr and Mr. Alfred H. Brooks. The topographic mapping is to be done by Mr. Edward C. Barnard, Mr. William J. Peters, Mr. Robert Muldrow and Mr. William S. Post. These regular officers of the Geological Survey are assisted by a small force of picked men, whose reliability and endurance has been tested by many years of service in the rougher parts of the United States.

On arriving at Skagway, it is planned to drop Mr. Barnard with his assistants. This small party will proceed to the Klondike region by the most accessible route and from there down the Yukon to the international boundary between British Columbia and Alaska. On reaching this locality, work will be begun on the topographic map of the area lying immediately to the west of the 141st meridian and adjacent to the Yukon.

The party under charge of Mr. Barnard will be accompanied as far as the upper ramparts of the Yukon south of the Klondike region by a second party, in which Mr. Spurr will have charge of the geologic work and Mr. Post of the topographic. On reaching the vicinity of the Klondike region, this second party will turn back southerly up the White River for the purpose of exploring this stream, especially that portion west of the international boundary and south of the area to be mapped by Mr. Barnard. Crossing over the divide at the head of White River, it is probable that they will proceed northwesterly down the Tanana, which flows in a gen-

eral way parallel to the upper part of the Yukon and enters this stream near St. James Mission.

Leaving the parties at Skagway, the main expedition will continue to Cook Inlet and up to the mouth of Sushitna River, which enters near the head of the inlet. Proceeding northerly up this river, it is proposed to reach a point at about the latitude of Fort St. Michael, where it is reported that several forks of the river unite. At this point Mr. Peters, topographer, with Mr. Brooks, assistant geologist, will leave the main party and proceed northeasterly into the country between the Copper River and the Tanana, connecting their traverse map with that made by the party under the direction of Mr. Spurr. The remainder of the force under Mr. Eldridge will proceed westward to the headwaters of the Kuskokwim and continue down that stream to the point where it approaches the lower Yukon and passing over the usual portage they will join the others at St. Michaels.

In addition to the Survey parties mentioned other expeditions have been sent out by the War Department. One of these, under Capt. B. Eldridge, is expected to explore the region near the Dalton trail or to the west on American soil. Two other parties are intended for Copper River and Cook Inlet, accompanying which are two assistant geologists, Walter C. Mendenhall and T. C. Schrader. At the same time the channels at the mouth of the Yukon are to be sounded by parties sent out by the Coast and Geodetic Survey. Thus it is expected by the end of the season to obtain fairly complete information concerning the accessibility to the interior by the various mountain passes and principal waterways. Coöperation has been established among various bureaux of the Government, by which a combined attack from different directions is being made upon the almost unknown areas. With the fairly accurate information thus obtained, the development of the natural resources of Alaska is in a fair way toward realization, and with the disappearance of the cloud of doubt and uncertainty which has surrounded this vast interior country there must result the destruction of many of the hazardous or even fraudulent speculative schemes now too prominently forced upon the attention of the public.

Forest Reservations.—The surveys of the Forest Reservations, to which reference has frequently been made, are adding to the knowledge of the least known parts of the United States both as to position of topographic features and to resources in timber, in grazing and less directly in mineral wealth. The Reservations

themselves are apparently in a somewhat insecure position, as attempts have been made by the Western Senators to nullify those recently proclaimed by President Cleveland. By act of Congress, approved June 4, 1897, surveys and examinations of the Reservations were begun and carried on as rapidly as possible during the remainder of that year. Further work has been suspended during the winter, but is to be renewed as soon as the melting of the snow in the mountains will permit access to the various areas. Without waiting, however, for the results of these surveys or for changes or modifications that may be made in the boundaries of the Reservations, the Senate, at the instance of some of the Western members, has attempted to indefinitely suspend the operation of the President's proclamation and to restore to the public domain the areas thus set aside. Considerable interest has been aroused in the matter, as there is apparently a growing belief both East and West in the desirability and even necessity of setting aside the vast tracts of land, mountainous in character, valueless for farming purposes and of use mainly for the production of trees. The withholding of these lands, it is believed, will be of great benefit to the development of the country and cannot work injury to any legitimate occupation, since mining is permitted and lands which are capable of being tilled are excluded.

A somewhat detailed report of the forest reserves has recently been made by Mr. Gifford Pinchot, a professional forester, formerly connected with the management of the timber properties of the Vanderbilt estate at Biltmore, North Carolina. In this he shows that by far the greater part of the reserves is covered with growing trees. The areas, however, include considerable tracts which have been stripped by occasional fires. In general it is probable that most of the forests throughout the country have been burned and have grown again during recent geologic periods. Given time enough, there is little doubt but that this process of natural reforestation will be repeated on the lands now devastated. On all sides successive steps in the return of burnt areas to fertility may be observed. Such lands will resume their former character if the increasing fires due to the presence of man can be checked.

The lands included within the reserves are for the most part capable of producing forests and may with propriety be held for this purpose. In comparison with the danger from fire, the loss to the national timber lands from cutting is almost insignificant. On the other hand, it may be said that under the present system of getting out timber, fire is almost sure to follow the logger. With the

progress of settlement the loss or useless waste by fire is increasing with geometrical progression. The time required for new growth upon the burnt lands is long when compared with human life, and in general it may be said that at least a century must elapse before merchantable timber can be obtained.

The protection of timber is, however, not the sole reason for making the reserves. According to Mr. Pinchot, the forests have a favorable influence upon water-supply, performing in this respect a double function; on the one hand they serve to maintain the flow of water in the streams during times of drought, and on the other hand they are a powerful agency for the prevention of destructive floods.

The report of Mr. Pinchot, prepared for the use of the Secretary of the Interior, dwells particularly upon questions of administration—a matter which, though well worked out in several countries in Europe, has received little or no attention in the United States. It is urged that, in place of our characteristic American method of administering public affairs through political appointees, a corps of technically trained forest officers be created. The peculiar responsibilities placed upon the forestry officials demand a high standard of fidelity, honesty and ability, in addition to technical skill. To illustrate the dangers arising from the employment of men not possessing these qualifications, there has been cited the temptation to loose management, as in the matter of over-cutting. To cut too freely may involve the ultimate impoverishment and destruction of the forest. While the cutting is going on it may add greatly to the popularity of the forest officer and perhaps to his professional reputation for getting good supplies of timber and large money returns. If he be appointed for a limited term, as for four years, he may succeed in stripping the forest, and the results of his mismanagement not appear for years. The only safeguard against such danger is to be found in the creation of the professional spirit which results from a thorough training and devotion to a lifelong occupation.

The importance of beginning right in forest management is one which can scarcely be overestimated, since precedents or traditions are rapidly acquired and soon determine the character of the service. The confidence and good will of the local populations are essential and at the beginning are easily won or lost.

It is recommended that under a chief forester for all of the reserves and aided by one general inspector, there be 7 forest rangers, each of whom should reside in or near the reserves and

should be held responsible for proper conduct of the work. These should make frequent inspections, keep necessary books and accounts, issue permits for use of timber, and attend to general business management. They should be assisted by 20 forest guards, who should act as patrols, seeing that the rules and regulations are strictly performed and guarding against injury from fires.

In addition to this body of men, relatively insignificant when the vast extent of the public forests is borne in mind, there is suggested the employment of 165 fire watchers, to be paid from $25 to $50 per year, on condition that they bind themselves to repair with all practicable speed to every fire occurring within assigned limits, and use all efforts to extinguish it. The creation of a body of men pledged to prevent fires and to assist in fighting them is believed to be entirely practicable under the existing conditions. Although the amount of pay in each case is small, yet ready money is so scarce among the owners of the small ranches adjacent to the forest reserves that the inducement to earn even this sum is sufficiently great to insure reasonable promptness and care. It is estimated that the total expenditure for all employees will not amount to more than $45,000 per year, and, with the $25,000 additional for miscellaneous expenses, the total will amount to $70,000; an exceedingly modest annual appropriation, in comparison with the benefits, since the annual forest fires have often consumed timber whose value may reach to millions of dollars and whose indirect damages may be even greater.

The object of the forest operations in any reserve should be to harvest the largest amount of timber consistent with steady improvement in the value and usefulness of the forest. The details of the work must be dependent upon the requirements of each individual case. Lumbering operations should not be undertaken by the Government, but the function of the forest officers restricted to the selection of trees to be cut, their sale at public auction, and the enforcement of rules governing their felling and removal. All regulations should be directed in the line of safety from fire, continued reproduction of the forest, with improvements in composition and yield, the filling of local needs for forest products, and lastly, a fair return in money to the Government. The application of such principles must lead to widely diverse results in different forests. In some places nothing but protection from fire can be done for many years; elsewhere mature trees may be removed, while in other places the timber needed for near-by consumption can be taken with advantage to the forest.

The thorough system above outlined is still a matter dependent for its ultimate realization upon the education of our citizens in the resources and needs of the great West. Immediate personal gain and private interest are crying loudly against the broad policy of holding for the future anything which can be in part enjoyed at present. The firing of a mountain side covered with magnificent forest to afford a tourist entertainment for a single hour is apparently, in the minds of many, a more sensible proceeding than protecting the timber for the uses and needs of the unknown settlers who may gradually come in during succeeding years. License to take and destroy both timber and game is demanded as the right of the individual who is sufficiently adventurous to penetrate to regions beyond the lands now in private ownership. It is only by pointing to the struggles of citizens of the Eastern States in slowly restoring in part their wasted forests that our people can be brought to appreciate the necessity of foresight and of protecting the perishable resources of the West.

FLOODS IN THE MISSISSIPPI VALLEY.—The prevailing high water in the Ohio and Mississippi Valleys has, to a slight extent, renewed the alarm felt last year at the apparently increasing destructiveness of the floods along our great artery of internal commerce, and has called public attention to the studies which have been and are being made of the regimen of the river. These are founded on careful geographic research, or what may more properly be termed hydrographic investigations. The latest, and one of the most notable contributions to knowledge, is the report just printed, prepared by Capt. Hiram M. Chittenden, of the Corps of Engineers, U. S. A. The work was undertaken in conformity with a clause contained in the River and Harbor Act of June 3, 1896, providing for the examination of sites, and report upon the practicability and desirability of constructing reservoirs for the storage and utilization of water; to prevent floods and overflows, erosion of river banks, and breaking of levees. The further stipulation was given that one reservoir site at least should be surveyed in each of the States of Wyoming and Colorado.

After a broad study of the whole subject, the conclusion was drawn that it is perhaps physically practicable to build reservoirs of sufficient aggregate capacity on the watershed of any stream, even so large a river as the Mississippi, so as to exercise some influence in diminishing the height of floods. The great cost of such works, however, as compared with results to be expected, will

operate to prevent their construction unless the water thus held is needed for industrial purposes; in other words, the possible amelioration of flood conditions will not warrant the construction of great reservoirs, even if suitable localities for them existed. It is pointed out, moreover, that flood protection and industrial use are not entirely compatible objects. In order to hold the floods the reservoir should be kept emptied until needed, and should be again emptied as soon as possible, as local floods in a wet year may follow in quick succession. If used for industrial purposes, it is probable that not more than 50 per cent. of their capacity should be depended upon as reserve for flood storage.

One important geographic feature which the public at large does not appreciate is brought out clearly in this discussion. It is a common error to suppose that the great floods of the lower Mississippi come from the melting snows in the Rocky Mountains. As a matter of fact the floods of the Mississippi occur at seasons when the flow from the mountains is very small. At the time of the great flood of 1897, the Arkansas River contained practically no water in western Kansas, and the discharge of the Platte in Nebraska was relatively small. The destructive floods of the Mississippi are the result of heavy rains in the low region south or east of the Missouri. This stream, although it drains the largest catchment area, is not an important factor, the controlling element being the Ohio River.

The magnitude of the floods in the Lower Mississippi depends upon accidental combinations of storm-flow from many tributaries, no one of these, except the Ohio, being capable of producing serious consequences in the main river; but if, when the Ohio is high, several of the other tributaries discharge an excessive amount of water simultaneously into the main stream, great disasters are liable to follow. Fortunately, however, the flood waves from various directions usually arrive at different periods, and destructive combinations are infrequent.

It has been estimated that when the total discharge of the Mississippi at Cairo, above the bank-full stage, would cover an area of 8,500 square miles to a depth of 10 feet, to hold this would require reservoirs of an average of 10 feet in depth, and having an area equal to that of the State of Massachusetts, or about one-fifth the size of Ohio, Kentucky, or Tennessee. The topography of the headwaters of the Ohio and Upper Mississippi Rivers, while in a general way favorable for reservoir construction, is not of the character to permit the construction of storage work of this enormous

extent. On the Lower Mississippi, however, there are vast areas where, from the topographical standpoint, such storage of superfluous water might be had. The St. Francis Basin, lying along the river, has an overflowed area of 6,700 square miles. From head to foot this basin has a fall of 120 feet. It has been suggested by Mr. James A. Seddon, Assistant Engineer, U. S. A., that this might be divided by dikes into basins or compartments, distributing the slope of the basin in such a fashion that the compartments would succeed each other from north to south in a gradual descending series. The superfluous water stored in these basins could be gradually released, increasing the low-water flow and radically improving the navigation of the Mississippi from Helena to the sea. From this point, northerly, slack-water navigation could be provided through the basin by means of five or six locks suitably placed in the retaining dikes of the separate compartments.

The results of the surveys demonstrate that the construction of a general system of reservoirs in the arid region might cause an appreciable reduction in the flood height of the Missouri River during a June rise. This would not have any influence upon the destructive floods of the Mississippi, since these occur usually at an earlier date and originate from other causes. Although the reservoirs would thus be of little or no benefit to navigation, yet such works are indispensable to the development of the West through agriculture by irrigation. Private enterprise cannot successfully construct these great storage works, since under our present laws there is little or no security of ownership in waters thus held. As a public enterprise, however, the benefits both directly and indirectly must be largely in excess of the expenditures.

The geographical distribution of the flowing water, as it has been found day by day for a series of years at various points in the Mississippi River and its tributaries, is graphically shown by two plates prepared by Mr. James A. Seddon. These notable contributions to exact knowledge enable a person at a glance to grasp the combinations that make up the floods at Cairo, and also exhibit the progress of waters down the main stream. Beginning with the Missouri River at Sioux City, the daily fluctuations are shown throughout the years 1880–85 inclusive at this point, at Kansas City and at St. Charles near the mouth of the river. In the same way quantities at Prescott, Clayton and Grafton, on the upper Mississippi, are exhibited, at St. Louis, on the middle Mississippi, and at Paducah on the Ohio River; all of these being combined to make the total flow at Cairo.

Information of this character, giving our citizens correct knowledge of the geographical factors which limit or favor the development of the natural resources of the country, is of inestimable value in encouraging wise action or in preventing extravagant expenditure through erroneous impressions, such as those which have underlaid the popular demands for water storage in the arid region as the sure preventive of floods in the lower Mississippi.

Geographic Names.—The U. S. Board on Geographic Names, created September 4, 1890, has issued a pamphlet containing recent decisions up to January 1, 1898. This is supplemental to the first report printed in 1892, which contains 1,781 decisions. The recent report brings up the total number of decisions to nearly 4,000, or with county names up to over 6,700.

The Board was created in order that uniform usage in regard to geographic nomenclature and orthography might obtain throughout the Executive Departments of the Government, particularly upon maps and charts. It is constituted of departmental officers detailed from the various surveys or bureaux issuing maps and geographical publications. Its membership embraces ten persons, Mr. Henry Gannett, Chief Geographer of the U. S. Geological Survey, being chairman, and Mr. Marcus Baker, Cartographer of the same organization, secretary.

Among the decisions rendered are many of names concerning which there has been a long dispute. Two forms of the various spellings, Allegany and Allegheny, are given. The former is adopted for the town in Potter County, Pa., and the second for the river and mountains in the eastern United States. Cheyenne is taken as the official spelling of the river of South Dakota tributary to the Missouri, and not Sheyenne nor Shyenne, but the river of North Dakota tributary to the Red River is spelled Sheyenne. The now well-known starting point for the gold fields of Alaska is spelled Dyea. The highest known peak in the world is named Everest, and not Gaurisankar; while the well-known volcano of Japan is to be written Fujiyama, and not any one of the dozen or more forms which have been employed by different writers in the past.

There is a well-marked tendency to drop the word city as part of the name of the towns and villages so plentifully designated, especially throughout the West; for example, in Kansas, Garden City has been shortened to Garden, and Dodge City to Dodge. The principal city of Cuba is designated as Habana, and not Havana. The well-known narrow passage in East River, New York, retains

its familiar form of Hell Gate. The intermittent flowing river of eastern Colorado is correctly termed Purgatory and not Purgatoire, or, in the language of the cowboy, the Picket Wire. The creek and falls in the Catskills in Greene County, New York, has been definitely designated as Kaaterskill, while its neighbor in the same county is known as Plaaterskill. In writing about the gold fields of Alaska we are to use the word Klondike and not Clondyke or other combinations. The lake in British Columbia and the river in the same region and in portions of Montana is known as Kootenai, and the lake in northern Idaho is called Pend Oreille.

The familiar name of Grey Town, so often used in reference to the Nicaragua Canal, is replaced by the official designation, San Juan del Norte; while the seaport town of Egypt on the Red Sea appears as Suakin and not Sawakin nor Suakim. The Republic of South Africa is Transvaal and not the South African Republic. The well-known volcanic peak, the highest in sight from Puget Sound, is officially designated as Mt. Rainier, and, despite the earnest protests of the citizens of Tacoma, is no longer to be called Mt. Tacoma on the official maps. These and many other interesting decisions of general or local interest are to be found in the publication to which reference has been made. N.

# RECORD OF GEOGRAPHICAL PROGRESS.

## AMERICA.

CAUSES OF DISTRESS IN THE BRITISH WEST INDIES AND GUIANA.—Dr. D. Morris, Assistant Director of the Royal Gardens, Kew, wrote a long report upon the economic resources of the British West Indies and Guiana, the causes of whose distress were investigated recently by the West Indies Commission. His paper formed Appendix A of the Commission's Report, and on account of its importance it has been republished, and now appears as the first number of an additional series to the Kew *Bulletin* under the title of "A Report on the Agricultural Resources and Requirements of British Guiana and the West India Islands." His long studies in these regions and his intimate acquaintance with their conditions have enabled him to produce an accurate and impartial account of them. His report, of which *Nature* printed a summary (No. 1481), is a graphic illustration of the danger to any community of entire dependence upon one industry. This is a source of danger in several ways; commercially, because any large depreciation of prices involves the whole community in suffering; agriculturally, because bad seasons or hostile tariffs may at any time plunge the entire laboring population into great distress; and furthermore, the growth of one crop only sooner or later encourages the spread of disease and perhaps the ruin of industry.

These colonies have the area of Great Britain and Ireland, with the population of Wales. Little more than 2 per cent. of the entire area is under cultivation, and only 7 per cent. of the cultivable area. In fact, over twenty million acres are suitable for bearing crops, though only a million and a half acres are under cultivation. Guiana is the most valuable of these possessions. Its capabilities of development are almost unlimited, and yet it is one of the most distressed of the colonies. The inland districts are practically uninhabited, nine-tenths of the population clinging to the coast. The planters appear to regard every industry except sugar-growing as unworthy of their attention. Under the Dutch régime, previous to 1815, a great deal of coffee and cotton, as well as sugar, was raised, which proves that the soil is well adapted for other products, though now little is grown except sugar-cane. The soil is well adapted for rice, but it is not cultivated, and fifty million pounds

of rice are imported annually to feed the coolies of India, who compose a third of the population. The United States imports bananas to the value of $10,000,000, and yet British Guiana places no fruit on the market. It is observed that in the four essentially English islands of Barbados, Antigua, St. Kitts and Nevis, sugar is the only staple, while in the islands of Dominica, St. Lucia, St. Vincent, Grenada and Tobago, occupied by people who differ in language and customs from those of the other four islands, the cultivation of sugar has given place to cacao, coffee, spices and other products. Grenada is now quite independent of sugar.

Jamaica supplies a good illustration of the wisdom of selecting a variety of marketable commodities for cultivation in addition to the staple industry. In the early part of the century sugar was practically the only product for export, and this island suffered for a long time from partial crop failure or low prices before the idea was conceived of introducing other cultural industries. Jamaica still raises much sugar, but fruit has come to the front, and in addition large quantities of coffee, cacao, allspice, ginger, etc., are raised, so that the entire failure of the sugar crop would not be nearly so disastrous in its results as it would have been a quarter of a century ago. Dr. Morris does not propose anything that would tend to hasten the end of the great sugar industry, but he recognizes the need of supplementing the staple trade by a variety of other industries. He suggests the establishment of a department of economic botany and of agricultural instruction to promote the development of the resources of these islands.

Expeditions of the American Museum of Natural History.— The American Museum of Natural History has sent out two parties this spring to continue the ethnological studies that were in progress last year. Dr. Carl Lumholtz and an assistant have gone to Mexico, where Dr. Lumholtz had already made large collections for the Museum. The explorations this year will be confined to the northern part of Mexico, and the design is to elaborate the collections now in the Museum and fill them out where they are found wanting.

The other expedition, which will consist of Dr. Laufer and Messrs. Gerard Fowke, R. Dixon, and H. Smith, will spend a short time in British Columbia, but will devote most of its work to Alaska, particularly in the neighborhood of Bering Strait, where it will cross over to Asia and make investigations among the natives there. A number of Indians will act as guides and assist in collecting specimens, which will be shipped to this city as material for comparative

study. In Alaska and Asia the members of the party will live with the natives to gain a more intimate knowledge of their every-day life and pursuits.

THE GOLD FIELDS OF ALASKA.—The Geological Survey has met the great demand for information concerning the gold region of Alaska by issuing a pamphlet of 44 pages, with a large map showing the routes of travel and the distribution of the gold-bearing rocks in Alaska. The pamphlet is by Mr. S. F. Emmons, and its title is "Map of Alaska, showing known gold-bearing rocks, with descriptive text containing sketches of the geography, geology, and gold deposits and routes to the gold fields." The descriptive text is based upon Dr. Dall's paper on "Coal and Lignite of Alaska," in the Seventeenth Annual Report of Survey, Becker's "Reconnaissance of the Gold Fields of Southern Alaska," and the "Geology of the Yukon Gold District, Alaska," by Spurr, both of which appear in the Eighteenth Annual Report. The pamphlet contains a brief historical introduction, with a list of works giving information about Alaska. A geographical sketch of the region follows, with a description of the rivers, the climatic conditions, and the eight routes to the Klondike gold fields that have come into general notice. The last 28 pages are given to a geological sketch of the gold regions and those where coal, lignite and metals other than gold are found. The pamphlet will be most serviceable to all who are studying the mineral resources of Alaska and the neighboring Canadian territory, or who intend to go to the gold fields.

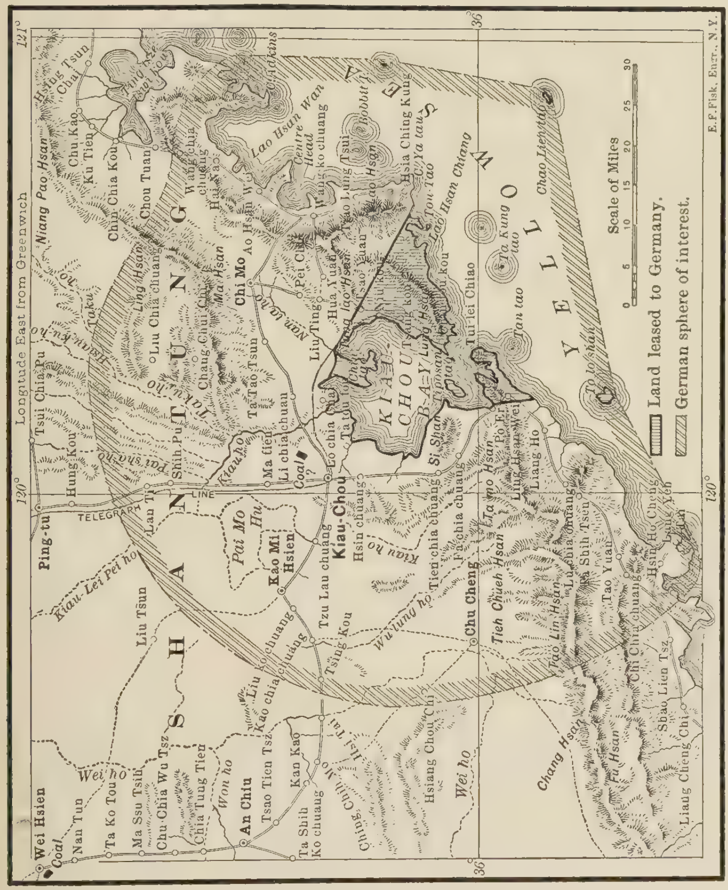
## ASIA.

THE GERMAN LEASE OF KIAU-CHOU BAY.—The accompanying map is based upon a map in *Petermanns Mitteilungen* (No. 2, 1898), from a Japanese map of Shantung. The Japanese map has a large amount of detail, and is also interesting as proof that, long before the recent war with China, Japan began to make preparations for such an event by geographical surveys in China.

The area of the leased territory is 360 square miles, of which 215 square miles are embraced by the waters of the bay. The land area of the sphere of interest is 2,790 square miles. The leased territory, under the terms of the treaty, is entirely subject to the political and legal control of Germany. Within the sphere of interest Germany is at liberty to carry out any enterprises for the commercial and industrial development of the district, including the building of railroads.

The entire coast line of China has only three great gate ways

admitting to the interior. These are the mouths of the Sikiang, Yangtse, and Peiho. The great advantage of Kiau-Chou Bay is that it offers the best means for communication with one of the most densely peopled and richest parts of China by means of minor river routes, fit for a considerable junk traffic, and by railroads yet to be constructed. It affords the best harbor on the coast of north-




east China, and as Prof. Von Richthofen has pointed out in his recent paper on "Kiautschou, seine Weltstellung und Voraussichtliche Bedeutung" (Berlin, Stilke, 1897), it derives additional importance from the fact that all the harbors on the coast of North China are silting up, a process which has been particularly detrimental to commerce at the mouth of the Peiho, on which is Tientsin, whose growth and importance have largely developed within the past ten

years. For three years, however, this important trade centre has been reached only by light draught coast steamers, to the great detriment of the business of the port. Along the whole coast of the gulf of Pe-Chili there is no other haven which is a gate way to the rich, thickly populated hinterland. Kiau-Chou Bay, on the other hand, is open to the interior and has the additional advantage of being free from ice at all seasons of the year. In the opinion of Prof. Von Richthofen, the coal of Shantung will be the largest article of export; but he does not think there can be a large development of the bay until it is connected with Wei Hsien and Tsi Nan, the capital of Shantung province, by rail, and eventually is pushed further west to form a junction with the great railroad from Pekin to Hankow, now projected. A railroad may be built from the bay westward along the valleys of Lai and Kiau which entirely cross Shantung. When this enterprise is carried out the trade of Chi-fu, on the north coast of Shantung, will be considerably affected, as it cannot so easily open communications with the hinterland.

Herr Otto Anz informs the editor of *Petermanns Mitteilungen* that silk culture is in a most flourishing condition in the central and southwestern parts of the province, and that this large district can supply enough raw silk for a large number of spinning mills. In this way the silk industry of Germany may be made independent of France, Italy, England and Switzerland, from which countries it now derives nearly all its raw silk. Another great industry of Shantung is the manufacture of straw braid for hat-making, in the production of which Shantung, within a few years, has surpassed the more northern province of Pe-Chili, formerly preëminent in this line.

MR. CAVENDISH'S TRAVELS IN AFRICA.—The *Geographical Journal* for April has a paper by Mr. H. S. H. Cavendish, the young Englishman who started in September, 1896, from Berbera on the Gulf of Aden and led an expedition fitted out at his own expense through Somali Land and around Lake Rudolf. He was the first Englishman to traverse this region, though much of the ground he went over has been visited by Dr. Donaldson Smith and the Italian explorer, Captain Bóttego. He accomplished the main purpose of the journey, which was to see the country to the west of Lake Rudolf, and he made some interesting discoveries. Cavendish found the west side of Lake Rudolf bordered by mountain ranges at a distance of five to thirty miles from the lake, the area between the mountains and the lake being a comparatively level plain covered

in part by thick bush or spear grass, with large intervening spaces that were nothing but sand. He ascended Mount Lubur, the dominating feature and one of the landmarks west of the lake, the top of which, according to his aneroid, is 5,300 feet above the sea. At the top is a crater nearly two miles across, in which are fresh-water springs and a good growth of grass, and here the natives take refuge in time of war with their flocks and herds. To the west, as far as he could see, were great chains of mountains covered with forests. No explorer has ever visited this district, and Cavendish desired to explore in that direction, but the native guides asserted that there was absolutely no water for many days' journey, and so he relinquished the project. In view, however, of the forested condition of the district it is not at all likely that it lacks an ample water supply.

On arriving at the south end of the lake he was surprised to find that Teleki's volcano, the first active volcano discovered in Africa, had entirely disappeared and where it stood was an absolutely flat plain of lava. It was only the year before that Dr. Donaldson Smith had seen Teleki's volcano, and the natives told Cavendish that about six months before his visit Lake Rudolf overflowed, and as the waters poured towards the volcano there was a great explosion after which the water swept in where the crater had been and put out the fire. There is now no sign of the crater in that place, but a field of lava extends to the lake and a new crater has opened about three miles due south, which, when Cavendish saw it, was not over 130 feet high. Perhaps the most interesting report which Cavendish brought home was that coal exists in large quantities near the south-east extremity of Lake Stefanie. The outcrop at the point where he discovered it was several hundred yards square. Major Lugard is of the opinion that if this coal field proves to be commercially valuable it will pay to build a branch of the Mombasa-Uganda Railroad north and use the coal on the railroad and on the steamers of Lake Victoria.

Mr. Cavendish believes that the river flowing into the north end of Lake Rudolf, whose identity has so long been disputed, is no other than the Omo of Captain Cecchi which is in accordance with the views of the late Captain Bóttego, though Donaldson Smith arrived at a different conclusion. The weight of evidence now favors the belief that the Omo sends its waters to Lake Rudolf.

Cavendish had far less trouble with the natives than other travellers in that region encountered. Among the Borani Gallas, where Dr. Smith fought nearly every step of the way, Cavendish says he

could go from village to village without fear of attack and could get a drink of milk anywhere, for which the natives invariably refused payment. His only serious difficulty was with the Turkana west of Rudolf, and he established friendly relations with them before he left their country.

Completion of the Congo Railroad.—A despatch telegraphed from Stanley Pool announces that the locomotive arrived on March 16 at Dolo, the terminus of the railroad at Stanley Pool. It was in March, 1890, that the first actual work on the railroad around the Lower Congo rapids was begun, and its construction has occupied just eight years. This road, which is 240 miles long, connects about ten thousand miles of navigable waters in the Upper Congo basin with the outer world, and will give to the vast interior of the Congo State commercial advantages that no other part of inner Africa is likely to possess for a long time. It is now generally admitted that Dr. Grenfell's statement is correct, that there is no part of the Congo basin that is more than a hundred miles distant from practicable steam navigation on the rivers; and with the other railroads, now projected, every part of the state, within the next ten or fifteen years, is likely to be placed within comparatively easy reach of Europe by steam communications.—(*Le Mouvement Géographique*, April 3, 1898.)

## THE POLAR REGIONS.

The Belgian Antarctic Expedition.—Dr. Frederick A. Cook of this city, who is a member of the Belgian Antarctic Expedition, wrote from Ushuaia, in the southern part of Tierra del Fuego, on December 27 last, that the *Belgica* was about to sail for the south, following the route of Captain Larsen in a general way, making the greatest southern advance possible during the Antarctic summer, and then turning out of the ice-pack to the sub-Antarctic islands of Prinz Eduard and Kerguelen and thence to Melbourne for the winter. Owing to difficulties with the crew which made it necessary to put five men ashore at Punta Arenas, where other men could not be obtained, the vessel was a little short-handed, and no attempt was likely to be made to land a winter party. If the programme has been carried out, the expedition should be heard from in Australia within a few weeks. The idea was, when Dr. Cook wrote, to recruit the expedition in Melbourne, and before the opening of the second Antarctic winter place a wintering party in Victoria Land and extend the expedition's stay to three years. The ship and the scientific *personnel* are all that need be desired.

Seeking Information of Andrée.—The Swedish Anthropological and Geographical Society has appointed Mr. J. Stadling, who accompanied Dr. Andrée to Spitzbergen in 1896, to make inquiries through Siberia for the purpose of learning if anything is known among the natives there as to the fate of the balloon. He started from Stockholm in April and may be gone till early next year.

German Plans for Antarctic Exploration.—The German Committee for South Polar research met at Leipzig, on February 19, and formulated a plan for the proposed expedition which is to start in August, 1900, under the leadership of Dr. E. Drygalski. The plan is to reach the South Polar region in the summer of that year, choose a suitable spot for wintering, carry on scientific observations at the station during the winter, and in the spring attempt to advance with sledges over the continuous Polar ice towards the Pole. In the autumn of 1901, it is proposed to follow the coast lines of the southern lands in the direction of the magnetic pole, and, if possible, to explore the west side of Victoria Land, the return being made thence through the pack-ice. The meridian of Kerguelen's Land is recommended for the advance southward, because (1) a serious attempt has never been made on that meridian; (2) its position in regard to the observatories of Melbourne and Mauritius renders it very favorable for magnetic work; (3) by this route the oceanic researches of the *Gazelle* and those of the deep-sea expedition led by Prof. Chun may be extended; (4) and the breaking up of the ice lately observed near Kerguelen's Land promises favorable conditions for the next three years. The *Geographical Journal* says that a complete programme for extended scientific observation covering the entire period spent in the Antarctic regions has been drawn up.

Is there an Antarctic Continent?—At the Royal Society meeting in London, on February 24, to discuss the "Scientific Advantages of an Antarctic Expedition," Dr. John Murray referred briefly to the theory of a large Antarctic Continent, which has received more prominence in his writings than in those of any other authority. He said that the form and structure of the flat-topped icebergs which are the most striking peculiarity of the Antarctic Ocean seem clearly to indicate that they originate on an extended land surface and have been pushed out over low-lying coasts into the sea. As these bergs are floated to the north and melt in warmer latitudes they distribute over the floor of the ocean a great quantity of glaciated rock fragments and land detritus, materials which were

dredged up by the *Challenger* in considerable quantity, and show that the rocks over which the Antarctic land ice moved were gneisses, granites, mica-schists, quartziferous diorites, etc.

On the other hand, Sir Joseph Hooker said that the ice barrier which Ross traced for 300 miles probably abuts upon land and possibly on an Antarctic Continent; but to prove this was impossible on the occasion of Ross's visit, for he was not able from the crow's-nest of his ship to overlook even the upper surface of the ice. Sir Joseph saw no other method of settling this important point except by using a captive balloon, with which he hoped future expeditions would be provided.

Dr. Nansen laid stress on the importance of exploring the Antarctic land. He doubted whether Dr. Murray's theory of a continuous continent is correct; possibly there are only a number of groups of islands, but there is no doubt that the ice sheets are far more extensive than that of Greenland and the study of them would yield more important results.

## GENERAL NOTES.

Meteorological Stations in the Atlantic. — Since 1892, Prince Albert of Monaco has been interesting himself in the planting of meteorological stations on islands in the Atlantic. The first fruits of his work are the establishment of two stations in the Azores, one upon San Miguel, in the east, the other upon Flores about 300 miles west. The station at San Miguel is connected with Europe by cable; that at Flores is 1,200 miles from the continent, and as yet has no cable connection with the outside world, though a cable will probably unite the island with America before long. The combined observations at these two stations will enable the ports of Europe to receive information of threatening weather at sea at least fifty hours before the storms arrive at the coast. When the necessary instruments are provided important information on terrestrial magnetism and seismic movements may also be communicated.—(*Comptes rendus de l'Académie des Sciences*, t. CXXVI.)

Tide Tables in the Gulf of St. Lawrence.—The Tidal Survey in the Department of Marine and Fisheries, Canada, has published, this year, for the first time, tide tables for Charlottetown, Pictou, and St. Paul Island, C. B., for 1898, with tidal differences for Northumberland Strait, and for the open gulf shore along the north coast of Prince Edward Island. These tables are based upon simultaneous observations of the tides obtained in 1896 and 1897, by means of self-registering tide gauges which were kept in contin-

uous operation at nine places in the south-west part of the Gulf. It has been thus ascertained that the tides in this region can best be deduced from St. Paul Island, which is at the main entrance by which the tides enter the Gulf from the Atlantic.

THE ANTHROPOLOGICAL EXPEDITION TO TORRES STRAIT.—The expedition from Cambridge University, England, to Torres Strait, south of New Guinea, started on March 10, finely equipped for thorough scientific work among the natives. The party is under the leadership of Dr. A. C. Hadden, Professor of Zoology in the Royal College of Science, Dublin, and he has seven assistants, including four medical men, a part of whose work will be the hygienic and medical aspects of anthropology. Dr. Hadden will study the physical characteristics of the natives and their decorative art. Mr. S. H. Ray, the well-known authority on Oceanic languages, will study their language and phonology. A new departure will be made in practical anthropology by Drs. Rivers, MacDougall and Myers, who will study comparative psychology in the field. Special attention will also be given to native music, all the animals and plants utilized by the natives will be identified, various appliances will be employed to test acuity of vision and color blindness, several cameras will be employed, a cinematograph will record native dances and actions, and phonographic cylinders will record the languages and music.—(*The Geog. Jour.*, April, 1898.)

PHYSICAL GEOGRAPHY.—The text-book on Physical Geography which Prof. W. M. Davis, of Harvard University, is now preparing, will be published by Ginn & Co., of Boston. It will lay special stress on the relations between the earth and man in order to show how largely the progress of history, sites for settlement, natural products of rock, soil and water, lines of travel and boundary are dependent upon geographical environment. The book will be illustrated by views from nature and sketches of typical land forms by the author. Such a book is greatly needed to connect the work of the lower grades with that of the college, and even more to give a broad knowledge of geographic forms and processes to the many students who do not reach college.

# MAP NOTICES.

BY

HENRY GANNETT.

Since the issuance of the last BULLETIN the United States Geological Survey has issued four sheets of the United States Atlas. One of these, Bennington, is in Vermont, and represents a section of the Green Mountains, which here rise high, broad and massive, the greatest altitude upon the sheet being Glastonbury Mountain, 3,764 feet.

In Texas, is one sheet, Uvalde, on a scale of 1:125,000, with a contour interval of 25 feet. The southern two-thirds of this sheet is a low plain, ranging in altitude from 750 to 1,000 feet, broken by numerous little buttes rising 200 or 300 feet above it. The northern third is a broken country, greatly eroded into small details, the relief being evidently made of soft beds, which are rapidly wasting away. The area is drained by Nueces and Frio rivers, which are intermittent streams, not only in time but in space.

In California is one sheet, Karquines, so named from the strait connecting Suisun and San Francisco bays. The scale is 1:62,500, and contour interval 25 feet. The western position of this area is occupied by the Coast ranges, which here barely reach an altitude of 1,500 feet. The eastern portion is occupied by Suisun Bay and by tule marshes.

In Oregon is one sheet, Coos Bay, on a scale of 1:125,000, with a contour interval of 100 feet. This represents a part of the Pacific coast of southern Oregon. It is a region of considerable relief, the Coast ranges rising to altitudes exceeding 1,500 feet. It is drained by Coquille and Coos rivers, both of which are extremely sinuous. The sinuosities of these streams are in part incised and in part are traced in broad flood plains. It is evidently a region which has been base-leveled, and subsequently elevated, and which is now again being depressed, after reaching a mature condition. Coos Bay, and the entrance to Coquille River, are drowned valleys, and the sluggishness of the streams is evidently due not so much to the fact that they have graded themselves, as that they have become graded by the depression of the land.

The United States Geological Survey has recently issued a map of Alaska, with descriptive text, under the title of "The Gold

Fields of Alaska, together with the Principal Steamer Routes and Trails." The base of this map is the Coast Survey map of 1898, on a scale of 1:3,600,000, or about fifty-seven miles to one inch. Upon this base are printed in colors the steamer routes to the principal points on the Alaskan coast and the routes and trails to the interior gold fields. The gold-bearing rocks, so far as known, are indicated by color, and the localities in which gold and coal have been discovered are marked. Upon the same sheet are given, upon enlarged scales, a map of the Klondike gold region and one of the trails over the passes. The map is accompanied by forty-four octavo pages of text, giving a history of the region, description of the routes to the gold fields, the modes of occurrence of the gold and the methods of mining it, and much other useful information.

*Central Alaska, Cook Inlet, Copper River, including Klondike, White, Tanana and Minook Rivers, scale about 30 miles to 1 inch, photo-lith., by J. B. Terrell, 1898, Washington, D. C., and Oakland, Cal.* In this map Mr. Terrell has embodied all the latest information accessible concerning the interior of the central portion of Alaska.

*Military Map of the Island of Cuba, prepared in the War Department, Adjutant General's Office, Military Information Division, 1898. Scale 1:250,000, eight sheets.* Relief is expressed by crayon shading. This is probably by far the most detailed and accurate map of the Island of Cuba which is extant, descending even to such details as by-roads and trails.

A portion of this same map embracing Havana province, has been published upon a larger scale, viz.: 1:125,000, and to it have been added many details not possible upon the smaller scale, such as individual farms, with their character, shops, acequias, ditches, etc.

Of the geological map of Italy, upon a scale of 1:100,000, six additional sheets have been received, and of the special geological map of Alsace-Lorraine, three sheets, upon the scale of 1:125,000, have appeared.

## BOOK NOTICES.

*The Diplomatic History of America, The First Chapter, 1452–1493–1494. By Henry Harrisse. London, 4 Trafalgar Square, B. F. Stevens, Publisher. 1897.*

Mr. Harrisse begins his work with an examination of the Portuguese claims to the Western World under the Papal grants, from the Bull of Nicholas V, of June 18, 1452, to that issued by Innocent VIII, September 12, 1484. These grants of "countries to be discovered towards the south and eastward, *usque ad Indos*," were held to include the Indies discovered by Columbus in his first voyage; but the three Bulls issued by Alexander VI, May 3 and 4, 1493, in response to the request made by Ferdinand and Isabella, established the Spanish title to all lands west of a meridian one hundred leagues west and south of the Azores and of Cape Verde. A fourth Bull, dated September 25, 1493, extended the field of maritime discovery in favour of Spain (always reserving countries already under the dominion of a Christian prince) in these words, translated by Mr. Harrisse from Navarrete:

> We amplify the donation and extend it with all its clauses to all the islands and main lands whatever, discovered or to be discovered, which in sailing westwards or southwards are or appear in the western, or southern, or eastern parts, and in those of India (p. 66).

The treaty of Tordesillas, signed June 7, 1494, fixed a line of demarcation between the Spanish and the Portuguese jurisdiction at 370 leagues west of the Cape Verde islands; a line which varied, according to the estimated circumference of the earth and the length of the marine league, between the meridians of 42° 30′ and 49° 45′ west from Greenwich.

Mr. Harrisse's fifth chapter is recommended as wholesome reading to those persons in England and America who made haste, two years ago, to join a writer in the London *Times* in denouncing the Papal Bull of Demarcation as *comical* and *ridiculous*.

A map of the eastern part of Brazil, from the mouth of the Amazon to Cape St. Roque, shows the line of division as drawn by different cartographers.

Sixty pages of notes and a full index complete the book, which is well bound and well printed on excellent paper, though disfigured in too many places by careless proof-reading.

On p. 23, for instance, the Bull of Alexander VI is dated *in the*

*year one thousand and ninety-three.* On p. 25 *distet* appears for *distat;* on p. 28 *constituæ* takes the place of *constitutæ.* On p. 157 we read *acquisitisant acquirendis* for *acquisitis aut acquirendis.*

These blunders may be laid at the door of the printer, but some one else is responsible for the whimsical *Amazona*, regularly used as the name of the Amazon, and for the two-headed paragraph on page 23, beginning with the words, *But forasmuch.*

*The Statesman's Year-Book. Statistical and Historical Annual of the States of the World for the Year 1898. Edited by J. Scott Keltie, LL.D., Secretary to the Royal Geographical Society, Honorary Corresponding Member of the Geographical Societies of Paris, Berlin, Lisbon, Amsterdam, Brussels, Buda-Pest, Geneva, Neuchatel, and of the Commercial Geographical Society of Paris, with the Assistance of I. P. A. Renwick, M.A., LL.B. Thirty-fifth Annual Publication. Revised after Official Returns. London: Macmillan and Co., Limited. New York: The Macmillan Company. 1898.*

The Year-Book for 1898 contains, like its immediate predecessor, 1118 pages of surprisingly accurate information. The maps are:

I. Illustrating the Niger Question.
II–V. Showing British Trade and Official Representation throughout the World.
V–X. Diagrams of the Rise and Fall in Imports and Exports for the past Twenty-five Years.

The trade maps do not please the eye. The diagrams are better, but less desirable than well-made tables. The Niger map illustrates, in the words of the editor, the present critical position in that part of the world, where three great Powers have contrived with infinite pains to get in each other's way. What goes on in Africa is repeated elsewhere, and it was an oversight not to show more fully what statesmen are doing for mankind.

*Geographical and Statistical Notes on Mexico. By Matias Romero. G. P. Putnam's Sons, New York and London. The Knickerbocker Press, 1898.*

In this handsome octavo volume the Mexican Minister at Washington has brought together, as he states in his preface, the several articles that he has published from time to time during his many years' residence in the United States, with a view to dispel errors prevailing here about Mexico, and so promote the good-will and increase the commercial, political and social relations between the two countries.

To these articles he has prefixed a body of statistical information which is not elsewhere to be found in English.

It is hardly to be expected that a work dealing with the details of production, imports and exports, revenues and the like, set forth in tables and columns of figures, shall be always correctly printed; but the table on page 120, entitled, Annual Buildings and Earnings of Mexican Railways, is made unintelligible by the proof-reader's neglect. The three right-hand figures in the first and second columns are decimals, printed without the decimal point. Where the author wrote 2.265 miles, he is made to say 2,265 miles. A similar error occurs on page 195. The total mileage of the Mexican railways was, in 1895, 7,388 miles. According to the message of President Diaz, of April, 1897, there were in operation 45,259 kilometers (28,124 miles) of telegraph lines.

For the fiscal year ending June 30, 1877, the federal revenue of Mexico amounted to $52,108,104.76, and the expenditures for the same year to $48,365,734.04. In 1896–97 the imports amounted to $42,204,095 and the exports to $111,346,494; the United States being entered for rather more than half of the importation and nearly four-fifths of the exportation.

Very interesting are the fifteen pages at the end of the book devoted to the great work now happily accomplished, the drainage of the Valley of Mexico. The canal and the six-mile tunnel through the mountains have a combined length of nearly fifty miles. A map and two sectional cuts illustrate the description.

*Across the Everglades. A Canoe Journey of Exploration. By Hugh L. Willoughby, Ex-Lieutenant Commanding Rhode Island Naval Reserve. Illustrated from Photographs Taken by the Author. Philadelphia, J. B. Lippincott Company, 1898.*

Mr. Willoughby's book adds something to the knowledge of the Everglades, but it is very hard reading. He had three objects in view: The exploration of the southern part of the Everglades; the surveying of a channel through the Ten Thousand Islands, and a reconnaissance of the southwest coast for the confidential charts of the U. S. Naval War College; and the collection of specimens of natural history for the University of Pennsylvania. His success in the second and third may be assumed; the line of the exploration is marked on the map, facing the first chapter, from the Harney River on the west coast in a zigzag direction to Miami on the east coast. The voyage was made in a canoe, in mid-winter, through a country of pure water, always in motion, and the air was

wholesome and full of life. The temperature was between 70° and 80°. One night, however, a norther brought the mercury down to 42°.

The water was nowhere very deep, and progress was slow with the pole, for the paddle is not used in the Everglades. The chief obstacle was the saw-grass, which grows to a height of four feet in thin soil, but sometimes to not less than ten feet. This grass has edges that cut like knives.

Mr. Willoughby and his comrade drank freely of the water at all times. It is a little hard, and much of it comes from the lower rock. Pools, eight or ten feet wide, occur all through the region. Occasionally, in the centre of the pool, there is a dark hole a few inches in diameter. A pole pushed into one of these holes met the water gushing out with force.

Game was plentiful, deer, otters, and many birds, conspicuous among them the white egrets.

Mr. Willoughby cherished the dream of finding an immense snake, but was obliged to put up with the common moccasin and the rattlesnake. He had a good look at a huge crocodile and hoped, with his *favorite shot*, *to sever the spine just in front of the fore-shoulder;* but the unfeeling brute slid out of the way, and left the hunter to make a list of all known crocodiles in six pages.

The Seminoles appear to be highly desirable persons. They are all, men, women and children, well-made, healthy and handsome, friendly and helpful to each other and to the whites, though, according to Mr. Willoughby, they consider *white man* and *liar* convertible terms. He adds:

> "I may overestimate their moral characteristics, but this I do know, that a Seminole would as soon cut his tongue out as lie. Whenever an Indian has stated something to be a fact, or has passed his word to me that he would do a certain thing, I have always been able to rely upon what he said to the very letter."

With their dove-like innocence the Seminoles combine the wisdom of the serpent in guarding their Eden. If a white man loses his way in the Everglades they will help him out; but they will not lead him in.

Besides the map and the numerous illustrations, the author furnishes an analysis of the Everglade water (p. 167), and a Seminole vocabulary, in which *cherries* and *chewing-gum* are duly entered, with their equivalents.

# ACCESSIONS TO THE LIBRARY.

## MARCH–APRIL, 1898.

### BY PURCHASE.

Works by John Croumbie Brown: Forestry in Norway, Edinburgh, 1884, 8vo; Forests and Forestry of Northern Russia, Edinburgh, 1884, 8vo; Finland, Its Forests and Forest Management, Edinburgh, 1883, 8vo; Management of Crown Forests at the Cape of Good Hope, Edinburgh, 1887, 8vo; Water Supply of South Africa, Edinburgh, 1877, 8vo; Forests of England, Edinburgh, 1883, 8vo; French Forest Ordinance of 1669, Edinburgh, 1883, 8vo; Schools of Forestry in Germany, Edinburgh, 1887, 8vo; The Agricultural Pests of India, by Edward Balfour, London, 1887, 8vo; On the Loadstone and Magnetic Bodies and the Great Magnet, the Earth, by William Gilbert, translation by P. Fleury Mottelay, London, 1893, 8vo; Mr. Gladstone and the Nationalities of the United Kingdom, a series of Letters to the "Times," by Sir John Lubbock, et al., London, 1887, 4to; History of the Afghans, translated from the Persian of Neamet Ullah by Bernhard Dorn, London, 1829, 4to; Supplement to Hain's Repertorium Bibliographicum, W. A. Copinger, Part II, Vol. 1, London, 1898, 8vo; Annual American Catalogue and The English Catalogue, 1897, New York, 1898, 8vo; Historia de la Provincia de la Compañia de Jesus del Nuevo Reyno de Granada, etc., etc., El Padre Joseph Cassani, En Madrid, 1741, folio; The Cabot Roll: The Customs Roll of the Port of Bristol, A. D. 1496 to 1499, translated by Edward Scott, introduction by Alfred E. Hudd, Bristol, 1897, folio; A Dictionary of Words used in the East Indies, London, 1804, 12mo; Topographisch-Historischer Atlas von Hellas, H. Kiepert, Berlin, 1846, folio; Atlas Russicus Mappa Vna Generali et Vndeviginti Specialibus, etc., Petropoli, 1745, folio; Nouvel Atlas physique, politique et historique de l'Empire Ottoman, par J. J. Hellert, Paris, 1844, folio; Minerva: Jahrbuch der Gelehrten Welt, 1897–1898, K. Trübner, Strassburg, 1898, 8vo; Life and Resources in America, prepared under the direction of Arinori Mori, Washington, 1871, 12mo; The Moors in Spain, by Stanley Lane-Poole, London, 1890, 8vo; Walks in Algeria, by L. G. Séguin, London, 1888, 8vo; Sand and Canvas: Adventures in Egypt, by Samuel Bevan, London, 1849, 8vo; Life in Sweden, by Selina Bunbury, London, 1853, 2 vols., 8vo; Sixteen Months in the Danish Isles, by Andrew Hamilton, London, 1852, 2 vols., 8vo; Christopher Columbus, his Life and his Work, by Charles Kendall Adams, London, 1892, 8vo; Hindostan, its Landscapes, etc., the Shores of the Red Sea and the Himalaya Mountains, a Series of Views, with Descriptions, by Emma Roberts, London (1845), 4to; The Orkneys and Shetland, by John R. Tudor, London, 1883, 8vo; South Africa of To-day, by Francis Younghusband, London, 1898, 8vo; Cabot's Discovery of North America, by G. E. Weare, London, 1897, 8vo; Description Géographique de la Guyane, par (Nicolas) Bellin, Paris, 1763, 4to; The Jesuit Relations and Allied Documents, edited by Reuben Gold Thwaites, Vols. XV, XVI, XVII, XVIII, Cleveland, 1898, 8vo; Across the Everglades, by Hugh L. Willoughby, Philadelphia, 1898, 16mo; Eastern Journeys, by Charles A. Dana, New York, 1898, 16mo; Annual Literary Index, 1897, W. I. Fletcher and R. R. Bowker, New York, 1898, 8vo; A History of the English Settlements in India, by J. Talboys Wheeler, London, 1878, 8vo; A History of the Sandwich Islands Mission, by Rufus

Anderson, Boston, 1870, 16mo; A Short History of Barbados, from its First Discovery, etc. (George Frere), London, 1768, 8vo; Ricerche Istorico-Critiche circa alle scoperte d'Amerigo Vespucci, ecc., Compilate da Francesco Bartolozzi, Firenze, 1789, square 8vo; Relation du Voyage du Port Royal de l'Acadie, par M. Diereville, Amsterdam, 1710, 12mo; The Red Man and the White Man in North America, by George E. Ellis, Boston, 1882, 8vo; Geschichte des Seefahrers Ritter Martin Behaim, von F. W. Ghillany, Nürnberg, 1853, 4to; The Missions of California, by Laura Bride Powers, San Francisco, 1897, 16mo; Who's Who?, 1898, edited by Douglas Sladen, London, 1898, 8vo; Whitaker's Almanack, 1898, London, 1898, 8vo; American Biography, by Jeremy Belknap, Boston, 1794, 1798, 2 vols., 8vo; A General Biographical Dictionary, by J. L. Blake, New York, 1835, 8vo; The Dawn of Modern Geography, by C. Raymond Beazley, London, 1897, 8vo; A Journey in Carniola, Italy and France, by W. A. Cadell, Edinburgh, 1820, 2 vols., 8vo; A Voyage to Cadiz and Gibraltar, by Lt.-Gen. Cockburn, London, 1815, 2 vols., 8vo; A Glance at the Interior of China, (Shanghae), 1845, 8vo; Recollections of a Visit to the United States, by Robert Playfair, Edinburgh, 1856, 8vo; A Trip to Mexico, by A Barrister (—— Forbes), London, 1851, 8vo; Records of Longevity, by Thomas Bailey, London, 1857, 8vo; Voyages dans l'Intérieur de l'Amérique Méridionale, par Julien Mellet, Paris, 1824, (2nd Edition), 8vo; History of New Hampshire, by Jeremy Belknap, Dover, 1812, 3 vols., 8vo; The Isle of Wight, by Sir H. C. Englefield, London, 1816, 4to; Works by Albanis Beaumont: Travels through the Rhaetian Alps, London, 1792, folio; Travels through the Lepontine Alps, London, 1800, folio; Travels through the Maritime Alps, London, 1795, folio; Irish Celts, (by James O'Brien), Detroit, 1884, 8vo; The Red Mountain of Alaska, by Willis Boyd Allen, Boston, (1889), 8vo; Memorials of a Half-Century in Michigan and the Lake Region, by Bela Hubbard, New York, 1888, 8vo; A Survay of London written in 1598 by John Stow, edited by Henry Morley, London, 1890, 8vo; The Gold Regions of South Eastern Africa, by Thomas Baines, London, 1877, 8vo; The National Gazetteer, by L. de Colange, New York, 1884, 8vo; The Diplomatic History of America, 1452–1493–1494, by Henry Harrisse, London, 1897, 8vo; Periplus, an Essay on the Early History of Charts and Sailing Directions, by A. E. Nordenskiöld, Stockholm, 1897, folio; Voyage Pittoresque et Historique de l'Istrie et de la Dalmatie, par Joseph Lavallée, Paris, An X–1802, folio; The Origin of Primitive Superstitions, by Rushton M. Dorman, Philadelphia, 1881, 8vo; Greece, Pictorial, Descriptive and Historical, by Christopher Wordsworth, London, 1839, 8vo; Illustrated Itinerary of Cornwall, (Cyrus Redding), London, 1842, 8vo; Journal of a Voyage in 1811 and 1812, to Madras and China, etc., by James Wathen, London, 1814, 4to; A Trip to Cuba, by Julia Ward Howe, Boston, 1860, 16mo; The Gypsies, by Charles G. Leland, Boston, 1882, 16mo; The White Hills, etc., by Thomas Starr King, Boston, 1860, 8vo; L'Amérique: Anthologie Géographique, par L. Didier, Paris, 1898, 12mo; Die Seehäfen des Weltverkehrs, von Alexander Dorn, Wien, 1891, 2 vols., 8vo; The Century Atlas of the World, Benjamin E. Smith, Editor, New York, (1897), 4to; Recueil de Voyages et de Mémoires, (Société de Géographie, Paris), Tome VII, Paris, 1864, 4to; A Letter written on October 4, 1589, by Captain Cuellar, of the Spanish Armada, to Philip II, etc., translated by H. D. Sedgwick, Jr., New York, 1895, 16mo; Vues des Cordillères, et Monumens des Peuples Indigènes de l'Amérique, par Al. de Humboldt, Paris, (1816), 2 tomes, 8vo; The Statesman's Year Book, 1898, edited by J. Scott Keltie and I. P. A. Renwick, London, 1898, 8vo; Dictionary of National Biography, edited by Sidney Lee, Vol. LIV, London, 1898, 8vo; Incwadi Yami, or Twenty Years' Personal Experience in South Africa, by J. W. Matthews, London, 1887, 8vo; L'Algérie et la Tunisie, par

Paul Leroy-Beaulieu, 2e Édition, Paris, 1897, 8vo; La Corée, Indépendante, Russe ou Japonaise, par Villetard de Laguérie, Paris, 1898, 16mo; Memoirs of Baron de Tott, containing the State of the Turkish Empire and the Crimea, etc., London, 1785, 2 vols., 8vo; Journal of a Tour and Residence in Great Britain, by Louis Simond, Edinburgh, 1817, 2 vols., 8vo; In the Track of the Sun, by Frederick Diodati Thompson, New York, 1893, 4to; Gibraltar, by Henry M. Field, New York, 1888, 8vo; New England's Memorial, by Nathaniel Morton, Plymouth, Mass., 1826, 12mo (reprint); A Popular History of the Discovery of America, by J. G. Kohl, translated from the German by R. R. Noel, London, 1865, 8vo; The First Republic in America, by Alexander Brown, Boston and New York, 1898, 8vo; Geographisches Jahrbuch, Band XX, 2te Hälfte, Gotha, 1898, 8vo; Fridtjof Nansen, von Eugen von Enzberg, Dresden, 1898, 8vo.

GIFTS.

*From Albert Perry Brigham, Author:*

Topography and Glacial Deposits of Mohawk Valley. (Bulletin of the Geological Society of America, February, 1898), Rochester, pr., 8vo.

*From Samuel Edward Dawson, Lit. D. (Laval), Author:*

The Voyages of the Cabots: Latest Phases of the Controversy. (Extract), Ottawa, 1897, pr., 8vo.

*From W. Bell Dawson:*

Tide Tables for Charlottetown, Pictou and St. Paul Island, C. B., for 1898, Dept. of Marine & Fisheries, Ottawa, 1898, pr., 8vo; Character and Progress of the Tides in Gulf and River St. Lawrence, by W. Bell Dawson. (Reprint from Transactions Royal Society of Canada), 1897, pr., 8vo.

*From Jules Leclercq, Author:*

Un Séjour dans l'Ile de Java, Paris, 1898, 18mo.

*From the Verein für Volkskunde in Lemberg, (Austria):*

Lud (Das Volk) Tom IV.—No 1.

*From the Ministerio da Marinha e Ultramar, Commissão de Cartographia, Lisbon:*

Eleven Maps:—Reconhecimento Hydrographico do Rio Limpopo, desde a sua fóz até á confluencia do Chengane, 1897; Plano do Porto e Cidade de Dilly, 2a Edição, 1895; Provincia da Guiné, Communicação entre o Rio Tombali e o Cacine, 1897; Provincia da Guiné, Esboço do Rio Corubal, entré o Rio Geba e Porto Ugui, 1897; Reconhecimento do Rio Geba, desde a fóz do Corubal até Geba, 1897; Provincia da Guiné, Reconhecimento do Rio Cacheu, 1897; Provincia da Guiné, Reconhecimento do Rio Mansôa, desde a sua fóz até ao Impernal, 1897; Provincia da Guiné, Reconhecimento do Canal do Impernal e Rio Mansôa, desde a fóz do Impernal até Porto Mansôa, 1897; Provincia de Moçambique, Reconhecimento hydrographico da Barra e Porto de Angoche, 1897; Africa Oriental Portugueza, folha No 4, Zumbo-Tete, 1897; folha No 8, Quelimane-Sofala, 1896.

*From the Mexican Minister at Washington, Author:*

Geographical and Statistical Notes on Mexico, by Matias Romero, New York and London, 1898, 8vo.

*From S. A. S. le Prince Albert 1er de Monaco, Author:*

Sur la Quatrième Campagne Scientifique de la "Princesse Alice," (Extrait); Sur les Observations Météorologiques de l'Océan Atlantique, (Extrait), (Paris), 1898, pr., 4to.

*From F. H. Newell:*

Supplement to Directory of Scientific Societies of Washington for 1897, corrected and brought down to 1898. Prepared by the Joint Commission, Washington, 1898, pr., 8vo.

*From Prof. Dr. Eugen Oberhummer, Munich, President:*

Bericht der Central Kommission für Wissenschaftliche Landskunde von Deutschland, von Ostern 1895 bis Ostern 1897. Berlin, 1897, pr., 8vo.

*From E. L. Plumb:*

Naval Station in the West Indies, Report, March 31, 1898. (55th Congress, 2d. Session, Report No. 816, Senate.)

*From J. de Rey-Pailhade, Author:*

Sur l'extension du système décimal au jour et au cercle entiers : avantages et procédés pratiques, (Paris), 1898, pr., 4to.

*From Henri de Sarrauton, Author:*

Sur le Système de l'heure décimale, les divisions du jour et du cercle, et la Table géographique. (Paris), 1898, pr., 4to.

*From Paul Eve Stevenson, Author:*

A Deep Water Voyage, Philadelphia, 1898, 16mo.

*From the Svenska Turistföreningen, Stockholm:*

Ärsskrift för är 1898 ; Cirkulär, 1898, Nr. 17.

*From the War Department, Washington, D. C.:*

Military Map of the Island of Cuba, prepared in the War Department, Adjutant General's Office, Military Information Division. From the Latest Official Sources, 1898. Scale: 1-250,000. Eight sheets. Havana Province, Cuba. Adjutant General's Office, M. I. D. 1898. Scale: 1-125,000. 1 sheet.

## NOTES AND NEWS.

Two announcements, received too late for insertion in BULLETIN No. 1, must be noticed:

The *Geographische Gesellschaft*, Hamburg, sent an invitation to attend the celebration of its Twenty-fifth Anniversary on the 17th of March. The programme included a general meeting in the forenoon and a dinner in the evening.

On the 16th of April the *Société de Géographie et d'Archéologie*, of Oran, Algeria, the fifth in order of time on the long roll of French geographical societies, was to celebrate its Twentieth Anniversary.

The Arctic Club of America desires to extend the privilege of membership to all throughout the world who are interested in Arctic and Antarctic exploration.

No initiation fee is asked, and the annual due of $1 from each member covers necessary mailing expenses and the cost of the annual catalogue, which will be sent to all. This catalogue gives details of biography and history.

Communications should be addressed to the Secretary,

ALBERT OPERTI,
151 West 35th St.,
New York City.

The *Verein für Siebenbürgische Landeskunde*, of Hermannstadt, will hold a meeting on the 22d of August, 1898, at Kronstadt, to celebrate its 50th Anniversary. The city of Kronstadt will dedicate at the same time a memorial statue to the Reformer Johannes Honterus.

The *Verein* extends a cordial invitation to all sister societies to participate in the festivities of this double celebration.

An *Esposizione Generale Italiana* will be held in Turin in the months April–October, 1898.

The classification embraces Ten Divisions:

I.—Fine Arts.
II.—Liberal Arts.
III.—Public Economy and Hygiene.
IV.—Chemical Industries.
V.—Mechanical Industries.

VI.—Electricity (International).
VII.—Manufacturing Industries.
VIII.—Agricultural Industries.
IX.—Italian Explorations, Emigration and Colonies, Commerce and Navigation.
X.—Physical Education and Sport.

There will also be an Exposition of Sacred Art, Ancient and Modern.

The programme of the Ninth Division, First Section, includes a Review of Italian Explorations from the Roman Expansion to the year 1888; the Explorations of the period 1888–1898; Private Expeditions; Expeditions under Government auspices; Cartography; Studies of the Land; Water; Climate; The Flora and the Fauna; Ethnography and Linguistics.

The Roumanian Geographical Society has just published the first Fasciculus of the great Geographical Dictionary of Roumania, under the direction of its Secretary, George John Lahovari, Gen. C. I. Bratianu and Prof. Gregory G. Tocilescu.

The Dictionary is in quarto form, three columns to the page, and the present fasciculus contains 160 pages, beginning with the word *Aaron-Vodă* and closing with *Bacăŭ*.

Paper and printing are excellent.

The *Société de Géographie et d'Archéologie d'Oran* issued this year in place of its first Quarterly Bulletin a Special Bulletin to commemorate the 20th Anniversary of the Society, which occurred April 16th, 1898.

Among the papers in this number are: *Le Nivellement général de la France, par Charles Lallemand; Deux Inscriptions relatives à des Généraux Pompéiens, par Héron de Villefosse; Un Portrait de Juba II, par P. Gaukler; Carthage—Découvertes de Tombes Puniques, par A.-L. Delattre;* résumés of the Society's past work, and a vigorous affirmation, by Emile Gautier, of what has been done in Algeria.

Mr. Peary's book, *Northward Over the Ice*, will be published May 21 by the Frederick A. Stokes Company.

## TRANSACTIONS OF THE SOCIETY.

MARCH–APRIL, 1898.

A Regular Meeting of the Society was held at Chickering Hall on Monday, March 14, at 8.30 o'clock P.M.

President Daly in the chair.

The following persons, recommended by the Council, were elected Fellows:

| | |
|---|---|
| Hartwell A. Wilkins. | John S. Phillips. |
| Charles J. Barnes, Chicago. | Charles Batchelor. |
| J. W. Hoffman, Orangeburg, S. C. | Mrs. James Herman Aldrich. |

The President then introduced to the Society Dr. Titus Munson Coan, who made an address on The Hawaiian Islands: the Country and the People.

On motion, the Society adjourned.

A Regular Meeting was held at Chickering Hall on Monday, April 11, at 8.30 o'clock P.M.

President Daly in the chair.

The following persons, recommended by the Council, were elected Fellows of the Society:

| | |
|---|---|
| J. Burke Wolfe. | M. D. Howell. |

The President called the attention of the Society to the invitation received in March from the Syndic and Municipality of Florence to the Celebration to be held in that city, April 17–27, in commemoration of Paolo Dal Pozzo Toscanelli and Amerigo Vespucci, two famous Florentines whose names are associated with the history of the discovery of the New World.

In response to this invitation the Council appointed as Delegate to the Toscanelli-Vespucci celebration Captain Alfred T. Mahan, U. S. N., retired.

A letter from the Department of State, under date of March 18, expressed the desire of H. E. the President to nominate, as Honorary Representative of the United States at the Celebration, the delegate selected by this Society.

This offer was thankfully accepted on the 23d of March, and Captain Mahan departed on his mission by the steamer *Fulda*, on the 28th of March.

President Daly introduced Signor Branchi, Consul-General for

Italy, who spoke briefly of the coming festivities in Florence and their significance for Americans as well as for Italians.

Portraits of Toscanelli, Vespucci, and Columbus were thrown upon the screen.

The President then introduced Mr. Clarence Pullen, who addressed the Society on the Mingling of the Races in Aztlan, and showed a number of views in illustration of his subject.

On motion, the Society adjourned.

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The interest in Arctic exploration takes various forms.

A plan for reaching the North Pole by a railway was submitted to the Council of this Society in January last.

The starting point was to be in Grant Land, "as far as one can come without being hindered by ice."

Things needed were these:

1. A steamer to reach the starting point.
2. Tracks.
3. Engine, with 10 cars.
4. One sleeping-car.
5. One car with provisions.
6. Coal and wood.

The party to consist of the inventor, one machinist and six workmen.

The tracks were to be laid, almost without effort, in this manner:

"In all cases a smooth surface must be obtained by blowing up any pack-ice that the tracks can be laid. These are made ready for laying, and *are extra prepared for that purpose.* Each track is 20 feet long and 1½ x 1½ inch thick; the weight of each track amounts to 40 lb. They can easily be fastened by a bolt one to another, are connected by three iron cross-sticks and held fast in the ice by two bolts on each side. So 3–4 miles can be laid every day. The expenses for each track of 20 feet will amount to $4.00, and as now 1,000 miles are to be laid and every mile costs $1,000.00, the total sum for all tracks being needed will amount to $1,000,000.00."

The engine to be of 100 horse power, and provided with a tank on each side for water.

While laying the tracks the party would always have the engine and one car at hand, with all things needful, including a light, "that we can see at our work during the long nights."

The cost of this simple solution of an old problem is estimated at $1,500,000, including wages and the "necessary amount of wood."

BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

**Vol. XXX** **1898.** **No. 3**

# THE PHYSICAL GEOGRAPHY OF NEW YORK.

BY

R. S. TARR.

## PART IV.—THE INFLUENCE OF THE GLACIAL PERIOD UPON TOPOGRAPHY.

INTRODUCTION.—When the Geological Survey of New York was undertaken, considerably more than half a century ago, the belief was current that the State had been overrun by great floods of water which had strewn the surface with the various deposits of boulders, gravel and clay which are so noticeable throughout the State.* Then came the glacial theory of Agassiz, at first vigorously opposed, but gradually accepted, until at present it is all but universally adopted as the real explanation of the phenomena formerly ascribed to the flood.

The farmers of the State till a soil brought to their land by an ice sheet of vast proportions, greater by several times than that now covering the great continental island of Greenland with 500,000 square miles of ice. They remove from their fields the boulders brought by the ice from the north, perhaps from even beyond the confines of the country, and they look upon a landscape modified, or perhaps even moulded, or entirely made, by this ice sheet. The lakes, the swamps, the gorges and the waterfalls have come to be what they are because of this glaciation; and the economic development of the State has depended in very large measure upon the

* See Eaton, Am. Journ. Sci., XII, 1827, 17–20; Dewey, Am. Journ. Sci. XXXVII, 1839, 240–242; Same, XLIV, 1843, 146–50; Emmons, Geol. of N. Y., Second Dist., 1842, 422–427; Hall, Same, Fourth Dist., 1843, 318–341; Mather, Same, First Dist., 1843, 158–228; Vanuxem, Same, 3d Dist., 1842, 212–224, 244–247; Lloyd, Quart. Journ. Geol. Soc., XXXII, 1876, 76–79.

visit of this ice sheet. Without this visit the industries, cities and people would have been very different.

Much interest has been aroused in the problems presented for solution by this latest great physiographic factor in the development of topography. Upon these problems much work has been done; but much remains still undone. New York State, though supporting a geological survey with some continuity for more than half a century, the results of which in a single direction have been of the best, has almost totally neglected this important subject. Hence, barring a few scattered individual efforts, and a single Government publication, almost nothing has been done to put before the people of the State the facts concerning their own environment. The farmer who would know the cause for his soils, or the teacher who would learn the meaning of the hills surrounding the school, or of the gorge or lake near by, can find no place in which to look for an answer to his queries. This stands to the discredit of New York State.* This discussion is bound therefore to be very inadequate because little is known.†

Before the Glacial Period.—Without careful and wide-extended study it would be impossible to tell in detail what the condition of New York was before the glacial period. This much is certain, however, that most of the larger features of land-form were then much as they are now. There was then an Adirondack Mountain mass, a Catskill Mountain group, and a dissected plateau in western and central New York; and each of these sections was then cut into hills and valleys, very much as they are now. The larger stream valleys, such as the Hudson, the Mohawk, and the Susquehanna, and also most of the smaller tributaries of these, then existed, although the details of stream course were in many instances very different from the present. Some rivers now flow into different valleys from those which they formerly entered, and still more flow in different parts of the old valleys, perhaps upon one side of the former course. The ice has planed down some of

* What is said of glacial geology applies equally to physiography in general, and also almost as fully to economic geology. The paleontology and stratigraphy are well known in some parts, but there is no adequate discussion of the salt, the iron, the oil and gas and the several mining industries of the State. In an intelligent and wealthy community such a condition should not exist.

† For statement of some of the principles of glacial geology reference may be made to Wright's Ice Age in North America; Wright's Man and the Glacial Period; Geikie's The Great Ice Age; and Salisbury's discussion in the Ann. Rept. of the State Geologists of New Jersey, for 1891, 35–108.

these hills to slightly lower levels than formerly, and rounded off still others, while the valleys have in many places been clogged, or in some cases even entirely filled, with glacial deposits.

But the most marked difference between the New York of to-day and the preglacial New York is in the introduction of numerous lakes. One could not safely assert that there were then *no* lakes in the State; but upon every physiographic argument that can be made, the existence of any but the smallest lakes seems highly improbable. Lakes must have a cause, and lake-making causes had apparently not been in operation extensively immediately before the glacial period. Therefore, the lakes, Champlain, Ontario, Erie, Chautauqua, the Finger Lakes, and the thousands of smaller ones, were probably not present. Of the larger number of these it may be stated positively that they did not then exist, for their cause is certainly glacial action.

At some time before the glacial period, the general altitude of the State was very different, being considerably higher above sea-level. Whether this was true at the very time when the ice encroached upon this region cannot be so certainly stated, though there is much reason for believing that, even as the ice gradually advanced, the land was standing higher above the sea than now.

Notwithstanding these differences between the present and past, could we have an accurate model of New York State upon a large scale, representing the conditions of preglacial times, one would have no difficulty in recognizing the *general* topography of the region in which he dwells. The general elevation might be higher than at present, and some of the hills higher above the valley bottoms. Some valleys may now be deeper than formerly; and, as a result of the glacial deposits, some now absent would then be present, and some now existing would not appear upon the model. The course of some of the rivers would be different, and most of the gorges, waterfalls and lakes would not be found, the site of the lakes being then valleys occupied by running water. Probably, also, the coast line was different in an important way. If the land were then higher, the coast line must have been somewhere to the eastward of its present position. So it follows that there were many differences, some of them of a very striking kind, but not so many as to make the general topography of the land unrecognizable.

The Advance of the Ice Sheet.—Over this land the ice front slowly advanced, coming on irresistibly, and fed from some centre in the far north, evidently in the vicinity of the Labrador Penin-

sula, from which the ice radiated outward in all directions, as the Greenland ice sheet of to-day radiates from a centre somewhere within that great ice-covered land area. Why it came cannot now be stated; nor can we say when it began, nor how long it stayed, nor when, nor why it went. Speculations upon this point are abundant, but they have been of little value in reaching definite and well-proved conclusions. The *fact* of the coming and going is all that can be stated with positiveness in this connection.


FIG. I.—TO SHOW PROBABLE EXTENT OF AMERICAN ICE SHEETS (CHAMBERLIN IN GEIKIE'S GREAT ICE AGE).

As the wall of ice gradually moved southward, involving States at present temperate in climate, and before that even warmer than now, there must have been a refrigeration of climate, partly due to the *presence* of the ice, and partly to the causes upon which the formation of the great continental glacier depended. Then, upon the high mountains, the winter snows must have lasted longer and longer into the summer, until the protected valleys held some of the snow throughout the entire season. At this time valley glaciers, somewhat like those of the Alps, probably appeared in the Adirondacks and Catskills, growing larger as time passed, and finally adding their supply to that of the great glacier from the north. This rose higher and higher upon the mountain sides, until, finally, the highest peaks of the Adirondacks and Catskills were submerged in the onmoving flood of ice, and all of New York State, with the possible exception of a small tract in the extreme western part, was transformed to a great ice plateau like that of Greenland to-day. From Labrador to Pennsylvania no land appeared above the ice covering, whose depth was certainly greater than a mile in some places. At present no similar ice sheet exists, unless possibly the one in the South Polar regions.

With the advance of the ice, plants were exterminated, and animals either exterminated or driven out to the southward. For a long time these conditions lasted, though how long, no one can

now say; and year by year the ice advanced through the valleys and over the hills and even the mountain tops. At first it swept

FIG. 2[illegible].—TO SHOW APPROXIMATE EXTENT OF ICE SHEET IN EASTERN UNITED STATES. "MORAINE OF SECOND GLACIAL EPOCH" SHOWN BY HEAVY SHADING. (CHAMBERLIN).

off the soil and rock, dragging it southward, and grinding it by rubbing particle against particle, or against the rock over which the glacier was slowly gliding. Valleys were deepened somewhat and

FIG. 3.—SURFACE OF THE GREENLAND ICE PLATEAU (PHOTOGRAPH BY J. O. MARTIN).

hills scoured by this great force of erosion, the hills losing some of their height and being rounded. The pebbles that the ice held, and the bed rock over which they were dragged were both grooved,

FIG. 4.—A GLACIALLY SCRATCHED PEBBLE (PHOTOGRAPH BY U. S. GEOL. SURVEY).

or scratched, and polished; and at all times during the stay of the ice, the glacier contained in its mass a load of rock fragments,

FIG. 5.—GLACIAL SCRATCHES ON BED ROCK (CALVIN, IOWA GEOL. SURVEY).

varying in size from boulders to clay particles, all slowly journeying southward with the ice, and being ground as they went.

At the margin, land appeared above the ice, at first as isolated hills, reaching above the ice surface, as the mountain peaks of Greenland project above this great glacier, forming the nunataks of that region; then, nearer the margin, as ranges of hills separat-

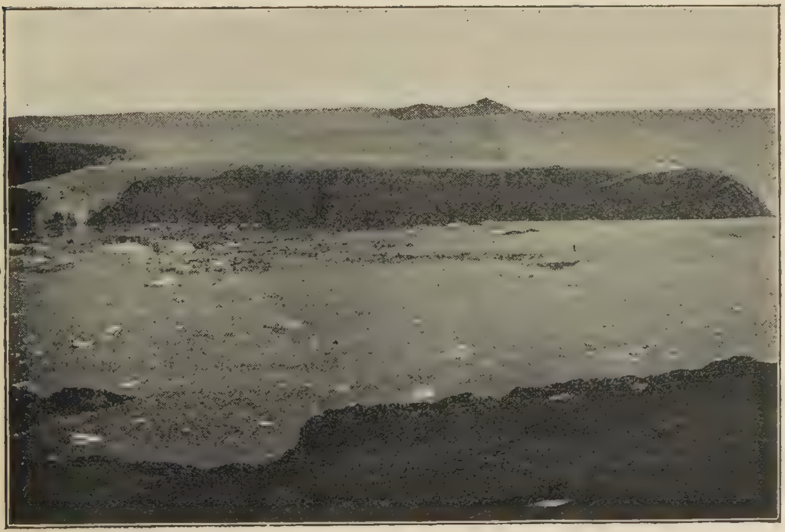

FIG. 6.—A NUNATAK RISING ABOVE THE GREENLAND ICE PLATEAU, CORNELL GLACIER (PHOTOGRAPH BY J. O. MARTIN).

ing projecting tongues of the glacier front,—small valley lobes projecting further southward along the valleys. The margin was evidently serrated or lobate, and the reason for the margin was that there the ice supply just equalled the ability of the sun to melt it.

So, along this margin, as along the margin of all glaciers on the land, there were vast floods of water poured upon the hill sides and gathered into the valleys. Here was supplied to river valleys the rainfall of other drainage systems far to the north. Some, falling where it now escapes into the Arctic waters or the St. Lawrence system, then passed on and entered the Susquehanna, or further west, the Upper Allegany, whence it was led to the Gulf of Mexico. As a result, many small stream valleys then carried large volumes of water. Sometimes the front of the ice was not in a valley sloping away from it, but toward it, and then, in such north-sloping valleys, glacial lakes were ponded back in places where now no lakes exist. The records of these are abundant.* In the north-sloping valleys this water was iceberg laden, and everywhere, where

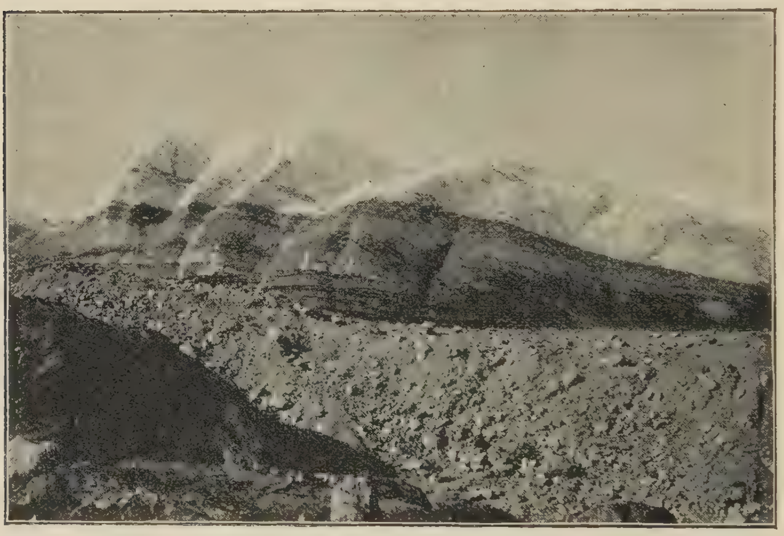

FIG. 7.—LAND MARGIN, CORNELL GLACIER, GREENLAND, SHOWING DEBRIS-LADEN ICE LAYERS NEAR BASE, AND TERMINAL MORAINE IN FOREGROUND (PHOTOGRAPH BY J. O. MARTIN).

it started from the ice, was ice-cold, so that, flowing into more temperate latitudes, it must have produced a very important influence upon the climate of parts of the South, especially along the Mississippi Valley, nearly all of the headwaters of which were supplying this ice-derived water.

* See Tarr (Part III of this series), Bull. Am. Geog. Soc., XXX, 1898, 44.

Not merely was *water* supplied to the streams, but much rock material also; for this too was constantly moving on with the ice to the place of melting. Some of this entered marginal lakes, forming lake deposits in places where now no lakes exist and some passed

FIG. 8.—BOULDERY TERMINAL MORAINE AT MARGIN OF CORNELL GLACIER, GREENLAND (PHOTOGRAPH BY J. O. MARTIN).

off in rivers, forming various types of river deposits,* often in valleys in which now the rivers are not depositing sediment. Not all of this rock load could go off in the streams, but much fell to the base of the ice, or remained in its place beneath the glacier. If the front of the glacier remained for a long time in approximately one

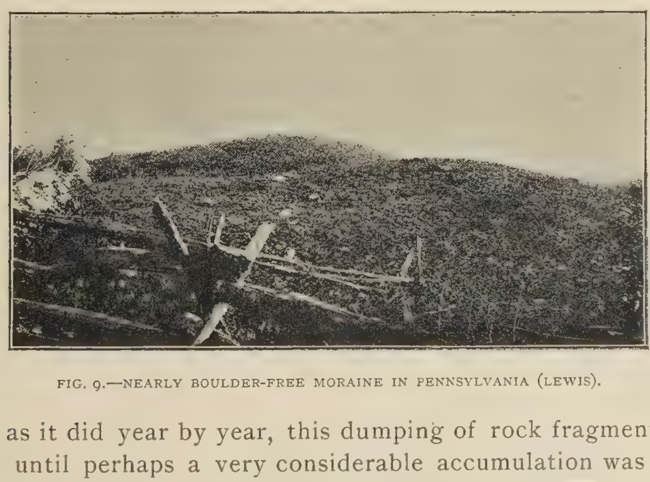

FIG. 9.—NEARLY BOULDER-FREE MORAINE IN PENNSYLVANIA (LEWIS).

place, as it did year by year, this dumping of rock fragments continued until perhaps a very considerable accumulation was made,

*See Tarr (Part III of this series), Bull. Am. Geog. Soc., XXX, 1898, 43 and 45.

forming a moraine. The former position of the ice front is now traced by these moraine hills and ridges, which extend across the country as indicated in the accompanying maps. The moraine formed upon the land is quite like that now being made at the margins of existing glaciers.

While throughout most of New York State the southernmost stand of the glacier front was upon the land, it is quite possible that the front in the Long Island region was at one time in the sea, as it certainly was farther east. In this case the glacial deposits were then dumped in the ocean near the ice margin, or such fine parts as could be floated away were removed by currents, to which transportation was added that done by the numerous icebergs which must have broken from the glacier front.

FIG. 10.—TO SHOW GENERAL EXTENT OF ICE IN NEW YORK. SOUTHERN LIMIT OF SHADING MARKS THE POSITION OF THE OUTERMOST TERMINAL MORAINE OF LEWIS AND WRIGHT, THE HEAVY SHADING THE SO-CALLED "MORAINE OF THE SECOND GLACIAL EPOCH" (CHAMBERLIN).

THE RETREAT OF THE ICE SHEET.—In time the conditions which gave rise to the Glacial Period began to change, and the ice supply was no longer able to maintain the ice front at the southernmost limit.* Then this line was abandoned and the ice front slowly melted back again, uncovering the country over which it had formerly advanced. This retreat or recession of the ice was intermittent, for we find evidence that at certain places the ice halted, and the front remained long enough to build terminal moraines, or *moraines of recession*, closely resembling that formed at the outermost terminus. Thus, for instance, after having passed well down into

* No attempt is made here to consider the question whether there was more than one advance of the ice, partly because it is a question still open and in controversy, but chiefly because its bearing upon the physiography of New York is not known.

Pennsylvania,* the ice halted for a long time along the line of the so-called "moraine of the Second Glacial Epoch," which is shown for central New York upon the map.† Numerous other halts were made, as shown by the map of the western New York moraines.‡


FIG. 11.—MAP OF MORAINES IN WESTERN NEW YORK. DIRECTION OF ICE MOVEMENT SHOWN BY ARROWS. DRUMLINS MARKED SOUTH OF ROCHESTER. OLD BEACH LINE SHOWN ALONG ERIE AND ONTARIO SHORES (LEVERETT).

Each of these halts is marked by a more or less well-defined moraine, formed at the terminus of the receding glacier. During the time of formation of these moraines the conditions at the glacier margin must have been closely like those described for the southernmost margin. Between these successive moraines the glacial recession must have been relatively rapid, for the front did not stand in any one place for a long enough time to permit the dragging of *débris* to the margin in sufficient quantity to accumulate morainic hills.

Thus it is seen that in New York State the ice front first *advancea* across the surface, visiting each part of the State, though the record of what it then did was mostly destroyed by the continued advance over all points excepting the deposits at the southernmost margin. Then this was followed by the ice *withdrawal*, during which each

* Lewis, Proc. Am. Phil. Soc., XX, 1882–3, 662; Proc. Am. Assoc. Adv. Sci., 1882, XXXI. 389–98; Am. Journ. Sci., 1884, Ser. III, XXVIII, 276–285; Report Z, 2nd Geol. Survey Pa.; Wright, Bull. 58, U. S. Geol. Survey, 1890.

† Chamberlin, Trans. Wis. Acad. Sci., IV, 1876–7, 201–234; Am. Journ. Sci., 1882, XXIV, Ser. III, 93–97; 3d Ann. Report, U. S. Geol. Survey, 1883, 291–402.

‡ Leverett, Am. Journ. Sci., 1895, L, Ser. III, 1–20.

part of the State was visited by the glacier front, this time, however, leaving a record of its visit which can now be read, especially at those places where the ice front lingered for a while and built moraines.

Thus it came about that moraines were formed at various points in New York, and that all over the State, every here and there, the water from the melting ice made deposits of gravel and clay derived from the glacier. These deposits, being made by water, are assorted and stratified. All glacial deposits are called *drift*, a name inherited from the time when they were explained as flood deposits. These

FIG. 12.—CROSS-BEDDED STRATIFIED DRIFT, ITHACA, N. Y. (PHOTOGRAPH BY C. S. DOWNES).

water deposits are called *stratified drift*, or sometimes *modified drift*, because they are not deposits direct from the ice, but modified through the intervention of water. Naturally the stratified drift is most commonly found in valleys, for it was here that the water went; but it is not *confined* to the valleys, for many a stream from the ice top, or from beneath the glacier, reached the edge of the glacier upon a hillside, or even, in some cases, upon a hilltop. Not only does the position vary, but the depth also, though, in general, the stratified drift is deepest in the valleys, being in some cases two or three hundred feet deep.

Held firmly in the ice, and dragged along beneath it, were rock fragments, bits of clay, pebbles, and great boulders, all journeying

southward; and, side by side, were coarse and fine fragments. As the ice was withdrawing, and these rock fragments were loosened by melting, some of them went away in the water to be deposited as stratified drift, but much fell directly to the ground or stayed in its place beneath the glacier. This drift was not definitely assorted, but was made of clay, sand, pebbles and boulders mixed indiscriminately together, for the ice was able to carry a large boulder as well as a bit of clay, a thing which water under ordinary conditions cannot do. Those deposits from the glacier form the characteristic soil of New York, particularly of the hillsides and hilltops, and, in places, of the valley bottoms. This is known as *till* or *boulder clay.* Thus it happens that a farm in one part may be bouldery and clayey, in another part clayey without boulders, and still elsewhere either sand or gravel. In each of these cases there was a cause, which, by careful study, can often be determined, though sometimes this is impossible because of the complexity of conditions attending the withdrawal of the ice, the full evidence of which is sometimes lacking. Many a resident of New York has been puzzled to know the reason for these variations.

With the withdrawal of the ice the conditions were again made favorable for the existence of animal and plant life upon the surface. Foot by foot the country was relieved of its ice blanket, and slowly the soil left by the glacier began to be made to nourish plant life and to furnish a dwelling place for animals. At first skirting the ice front there must have been strips of land entirely without vegetation. Then came the light-seeded grasses and small plants, and then the forest. During this bare condition the rain fell, and gathering into mud-laden rills, washed much of the imported soil away, as it now does on the roads and ploughed fields; and this sediment was added to the stratified drift from the glacier.

There is good reason to believe that the rains were perhaps heavier then than now, for the presence of the ice to chill the moisture-laden winds from the south, and the large amount of vapor that would be produced from the floods of the glacier-supplied waters, would bring about conditions favoring heavier rain. At this time, also, where the slope was sufficient for the removal of the sediment, the streams must have had more power to cut than now; and probably much of the gorge cutting in central New York was accomplished during this time,* when there was probably more water and when certainly the water that fell upon the surface flowed away more quickly, in the form of floods, than it did later

* Tarr, Amer. Geol., XIX, 1897, 135.

when its run-off was retarded by the forests. Also, at this time the streams had more sediment to serve as cutting tools than later when the soil was held in place by the roots of the forest trees.

What happened among the mountains with the *advance* of the glacier probably also happened with its withdrawal. The last stage of glacier retreat in Greenland, upon land from which the glacier has just withdrawn, is that of local valley glaciers. The same was true in New Hampshire and Maine; and, no doubt, when studies of the Adirondacks have been made, evidence of local valley glaciation will be found there in many places. At present no evidence of this has been put forward, and it therefore stands merely as an inference of probability.

MORAINES.—*Topography.*—In many places where the ice front stood for only a very short time, the moraine which accumulated at the margin is not very deep. Sometimes it is merely a tract of unusually numerous boulders; but in many places so much has been

FIG. 13.—THE TERMINAL MORAINE, WEST DANBY, IN CAYUGA VALLEY SOUTH OF ITHACA, N. Y. (PHOTOGRAPH BY C. S. DOWNES.)

deposited that the moraine forms a very striking feature of the landscape. This is particularly true of many parts of the so-called terminal moraine of the Second Glacial Epoch.* Among some of the moraines of recession to the north of this, as well as in the

* Chamberlin, 3rd Ann. Rept. U. S. Geol. Survey, 1883, 291.

earlier Pennsylvania moraine to the south of it, the morainic topography is also very strongly developed.

The terminal moraine is essentially complex, and this applies both to form and structure. In form, or topographic detail, it is typically a system of hummocky knolls, with intermediate valleys, often saucer and kettle shaped, forming distinct, closed basins. The hummocks may reach to the dignity of good-sized hills, perhaps 200 or 300 feet high, though commonly not more than half this. Their form is often quite circular or sometimes elliptical, and again ridge-like. The hummocky hills are put together in such a confused manner that there seems to be no order whatsoever, the form being, on a much larger scale, somewhat the same as that produced when many loads of sand are dumped near

FIG. 14.—LAKES IN KETTLE HOLES IN MORAINE OF COLORADO ROCKIES (PHOTOGRAPH BY JACKSON, DENVER, COLORADO).

together without any attempt at order. Some of the hummocks are steep, others gently sloping, some symmetrical, and others distinctly unsymmetrical. I know of no type of topography which simulates that of the moraine with the exception of the wind-blown sand deposits in a sand dune region. In such places, judging from the form alone, one might often imagine himself upon a moraine.

The moraine is not a distinct ridge, but a range of low hills and valleys, with a breadth from north to south of rarely more than two or three miles, though sometimes, as in the southern end of the valleys of the larger Finger Lakes of New York, from ten to fifteen miles in a north-south direction. When seen in a near view, the moraine exhibits a striking topography; but when looked at as part

of a general hilly region, its importance becomes entirely masked,* because of the lowness of the hummocks. Indeed, many moraines in hilly districts have not yet been detected because of this very fact.

Next of importance to the hummocks are the valleys, which are often true basins called *kettle holes.* In places these are so prominent that the moraine has been called a kettle moraine. † In these basins there is often no water, because the bottom is too porous and the water supply slight, coming merely from the rim of the tiny basin; but where the drainage area is larger, or the bed more impervious, the kettles are often transformed to ponds or swamps. Indeed, in some places there are so many that the moraine is literally dotted with tiny morainic ponds (Fig. 15). The depth of

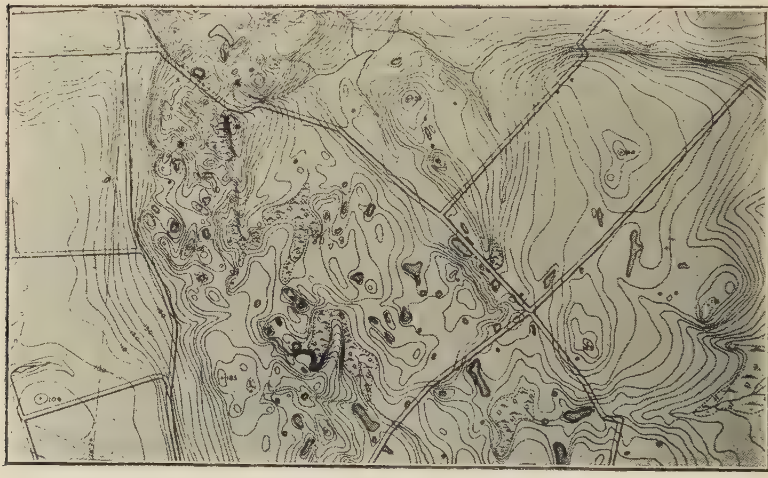

FIG. 15.—A PART OF THE NEW JERSEY MORAINE SHOWING (BY SHADING) NUMEROUS KETTLE PONDS (SALISBURY).

these kettles varies greatly, some mentioned by Koons being 50–90 feet deep.‡ These basin-like depressions are sometimes circular or elliptical or irregular, apparently being formed irregularly, as were the hills. Indeed, in many cases they are the spaces where morainic deposits were not made. The two types of form, valley and hill, cause a resemblance to the topography of sand dunes, in

* See Fig. 15 in Article III of this series, Bull. Am. Geog. Soc., XXX, 1898, where a very pronounced moraine, occupying nearly the entire valley south of Lake Cayuga, is masked by the general topographic features.

† Chamberlin, Trans. Wisconsin Acad. Sci., IV, 1876–77, 201.

‡ Koons, Am. Journ. Sci., 1884, Ser. III, XXVII, 260–264; Same, 1885, Ser. III, XXIX, 480–486.

which, between the more or less conical hills, there are numerous crater-shaped depressions or kettles.

*Structure.*—The internal structure of the moraine is also exceedingly complex. As in the case of the till sheet, it is sometimes almost free from boulders, sometimes exceedingly bouldery. In New York, the moraine is commonly rather free from large

FIG. 16.—THE BOULDERY CAPE ANN (MASS.) MORAINE (PHOTOGRAPH BY J. L. GARDNER 2ND).

stones, as is the till sheet also, the reason for this being that the rocks of the State are prevailingly soft and easily ground down. This is particularly true of central and western New York, where the scattered large boulders are mostly Canadian in origin; but in eastern New York there are places where boulders are more common, because of the greater hardness of the rock of the neighborhood and immediately to the north. In New England the prevailing condition of the till is bouldery, for the same reason.

When a morainic hummock is cut into and its internal structure revealed, it may be found to be till throughout, or it may be entirely made of gravel, or there may be a certain proportion of each of these. There is a complexity of structure which is most confusing; and one can see no law in the distribution of materials. Some moraines are prevailingly sand and gravel, others prevailingly till. One can rarely tell what will be found when a morainic hummock is cut through. There may be all till or no till, all stratified clay or

none of this, all sand and gravel or none; or some of each of these deposits may occur. Sometimes beds of sand or gravel are found

FIG. 17.—SECTION THROUGH A PART OF THE MORAINE IN CAYUGA VALLEY SOUTH OF ITHACA, SHOWING STRATIFIED DRIFT ON RIGHT AND UNSTRATIFIED TILL ON LEFT (PHOTOGRAPH BY C. S. DOWNES).

upon till. Again they occur beneath the till, or possibly sandwiched between two till beds.

*Explanation of Morainic Irregularities.*—There must be a cause for this variety of form and structure. In any specific case it would be exceedingly difficult to find the cause for each of the hills and kettles; and, indeed, even in general terms the explanation of these irregularities is not agreed upon. Professor Salisbury * considers moraines to be chiefly the result of accumulations of drift under the frontal edge of the ice, to which place it has been dragged and there left, because near the thinner ice edge it was impossible to carry the drift load further southward. To this cause is of course added certain supplies of material which was dumped from the ice-front as that melted, as well as some that was pushed or "shoved" up to the margin by ice advance; but these two last causes are believed to be subordinate. Other glacialists assign to the dumping process the chief importance, and still others believe that shoving has been of most importance. In fact, Professor Shaler † speaks of the "shoved moraine" as a synonym for a part of the terminal moraine.

* Ann. Rept. New Jersey Geol. Survey, 1891, 81.

† Ninth Ann. Rept. U. S. Geol. Survey, 546.

This is not the place for a discussion of the merits of this question. In fact, little good would come from such a discussion, for the matter resolves itself largely into a consideration of just how the individual conceives that the ice worked. It seems very probable that, at different times, or in different places, as the circumstances varied, either of these causes may have predominated. My own conception of how a moraine is built is that the dumping predominates in the main, with shoving as of secondary importance, while submarginal accumulation is more rarely of prime importance. This is based partly on my own conception of ice work, partly upon a somewhat wide-extended view of the terminal moraine of the eastern part of this country, and partly upon a study of the extensive moraine now forming in Greenland along a part of the margin of the great continental glacier. The statement that follows is therefore advanced purely as my own conception, and not necessarily that of others. It is recognized that very likely in the west, where the ice load was greater, submarginal accumulation may have been very much more important than it seems to have been in the east, and vastly more important than it *is* in Greenland.

The ice carried a greater amount of *débris* to some places than to others, partly because it actually had more material to carry, and partly because it was moving faster in some places than in others. This is one element of irregularity. Here and there this difference in supply may express itself in morainic accumulations *under* the margin of the ice; but wherever I have carefully studied the moraine there has been found no evidence that this was so. In Greenland, and evidently also in New York and New England, the chief moraine supply seems to have been from the ice front. This ice this season perhaps different from last, just as living glaciers change front, while holding a general position, shifted somewhat, being their front in different seasons. Hence material previously deposited at the glacier front may have been overridden, and perhaps shoved up into ridge-like hills; or, if the ice withdrew, new areas would be opened to the process of dumping.

All of this time the ice is moving up to the end, bearing its load, which, when the ice melts, slides down to the base in the form of pieces varying from bits of clay to large boulders, and more perhaps coming to some places than to others. This process may be actually seen in Greenland to-day. If the ice advances, overriding, or possibly even shoving some of the moraine in front of it, the deposits are heaped up even more irregularly than by the first dumping. That something of this sort has happened is indicated by the fact

that in the moraine the strata are often tilted and broken, showing that they have been subjected to some force.

Hills and valleys are formed as the ice front changes its line of dumping. This is the cause for the hummocky topography in the Greenland picture (Fig. 8), and seems perfectly competent to explain the similar irregularity in this country. In fact, until proof is brought to the contrary, this view seems to stand best supported by fact.

The irregularity of form described above, as well as the irregularity of texture, is increased greatly by the action of water from the ice. In some cases the moraine is being built upon a hillside sloping away from the ice, and then the water may remove much that the ice brings; but if the opposite is true, very little escapes, so that, with the same rate and amount of till supply, we may have great or small moraines built according to whether or not the water carried off much of the drift.

This cause for the irregularity applies equally in a small way. Here a stream was cutting a hummock away; there it was depositing a part of that which it had removed, perhaps in little marginal lakes extending along the ice front. Hence the conditions were exceedingly complex, so that, naturally, the results were complex both as to structure and form. This complexity of conditions exists along the Greenland ice margin at present and probably also existed in this country.

While advocating this view, it is not insisted that submarginal accumulation is impossible, nor are the three causes above mentioned *all* that were possible. The surface of the ice may have become covered with rock *débris*, as may be seen in the Malaspina Glacier of to-day; and this, through irregularity of melting of the ice which the *débris* covered, may have assumed distinctly morainic form and structure, and then, as the ice melted, have been dropped to the ground to add to the other accumulations. Again, *débris* washed from the land to the ice margin, or even out upon it, may have helped make the moraine. Such an origin is indicated for a part of the moraine in the Lake Cayuga valley, and apparently accounts, in part, for its remarkable development in that valley, while elsewhere along the same morainic line, the topography is generally especially marked only in the valleys, and is sometimes almost indistinguishable.

*The Extent of the Moraine in New York.*—No attempt will be made here to tell in detail about the distribution of the New York moraines. What little is known is mostly told upon the accom-

panying maps (Figs. 10 and 11); but it is to be understood that the Chamberlin map is an approximate and generalized expression of morainic districts and will not bear the test of local criticism. Numerous moraines are not placed upon it, and those that are, are not always correctly placed. It was based upon a preliminary reconnaissance, and, unfortunately, nothing of a more accurate nature has since been done in the greater part of the State.

A few words of a general kind may accompany this map. It will be noticed that the moraine enters New York from the southwest, just to the southwest of the lower end of Chautauqua Lake. There at Jamestown it is remarkably well developed, and, from this point, the lines of moraine diverge, one passing northeastward toward the west boundary of the Genesee Valley, the other passing very near Salamanca southeastward into Pennsylvania, and thence on to New Jersey.* With the interpretation of Lewis and Wright, that the southernmost moraine is in reality the outermost moraine of the last glacial advance, I am in full agreement. The facts presented by these writers have never been satisfactorily disproved, and one who has gone over the region can hardly fail to accept their conclusions. Therefore, notwithstanding the difference of opinion expressed upon Chamberlin's map, I accept the interpretation of the Pennsylvania geologists.

According to this view the actual terminal moraine entered New York State, aside from the Long Island region, in only one place, which is the place where the ice front stood farthest north in eastern United States. The reason why the glacier did not reach farther south in western New York is partly the effect of the very high plateau region of rugged topography which exists in northern Pennsylvania and southwestern New York. This actual terminal moraine of Lewis and Wright is well developed in central New Jersey, and again enters the State of New York in New York Bay, where it crosses to Long Island. The sandy and hummocky hills of this island are in large part due to the remarkable development of the terminal moraine,† which may be traced still further east-

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* This moraine is the one described by Lewis and Wright. See reference, page 193.

† Bryson, Geol. Mag. X, 1883, 169–171; Amer. Geol. III, 1889, 214; Same, 1893, XII, 127, 402; Same, 1894, XIII, 390; Same, 1895, XV, 188; Same, 1895, XVI, 228; Dana, Amer. Journ. Sci., 1890, XL, Ser. III, 425–437; Same, 1891, Ser. III, XLI, 161; Hollick, Trans. N. Y. Acad. Sci., XII, 1893, 189–202, 222–237; Same, 1895, XIII, 122–130; Same, 1894, XIV, 8–20; Same XV, 1895, 3–10; Same, XVI, 1896, 9–18; Lewis, Am. Journ. Sci., 1877, XIII, Ser. III, 142–146; Mather, N. Y. Geol. Survey, 1st Dist., 1843, 271; Merrill, Ann. N. Y. Acad. Sci., 1883–5, III, 341–364; Upham, Am. Journ. Sci., 1879, XVIII, Ser. III, 81–92, 197–209.

ward upon Block Island, the Elizabeth Islands, Martha's Vineyard and Nantucket. Although probable, it is by no means certain that the Long Island moraine is the actual terminal moraine, for it is still possible that the ice front to the south of New England was at one time in the sea to the southward of Long Island. In that case the Long Island moraine may correspond with one of the later halts, possibly with the well developed one in west central New York. Much careful work is necessary before the exact correlation of the several moraines is possible.

North of this extreme terminal moraine are numerous morainic patches, and somewhat indistinct lines of morainic topography, many of which are not yet located and correlated. There is also some moraine in the valley of the Chemung and Susquehanna Rivers, as well as in some of their tributaries, indicating a series of brief halts of the ice. Still further north, in the Genesee Valley, and along the headwater region of the Finger Lakes, and thence northeastward to the Mohawk, there is much moraine, indicating a prolonged halt of the ice, with the front by no means uniform in position. The history marked by this development of moraine has never been worked out, though it is not so simple as might be supposed from the map (Fig. 10). There were numerous minor halts and fluctuations of position in the general stand in this vicinity. This moraine is strongly developed, but from the valleys alone one would get an erroneous notion of its importance. There are places on the hills where this moraine, strongly developed in the valleys, is traced with difficulty. The detailed work of Leverett,* indicated by the map (Fig. 11), gives some idea of the complexity of the ice withdrawal from western New York.

North of this well developed morainic band there are others, the best developed one being north of the Finger Lakes, and not shown by the Chamberlin map. In the Adirondack region there are other moraines of recession.† Concerning the moraines of the Adirondacks, the Catskills, and other sections of eastern New York, practically nothing is known.‡ There certainly are moraines in this region, as there are in New England; and in all probability the

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* Am. Journ. Sci., Ser. III, L. 1895, 1–20.

† For an interpretation of the withdrawal of the ice front from North America, see Upham, Am. Journ. Sci., 1895, XLIX, Ser. III, 1–18; Bull. Geol. Soc. America, VII, 1896, 23; Chalmers, Amer. Journ. Sci., 1895, XLIX, Ser. III, 273–275.

‡ Some notes on Glacial Geology of New York will be found in the following: Dana, Am. Journ. Sci., 1863, XXXV, 2d Ser., 243–9; Stevens, Amer. Journ. Sci., 3d Ser., 1872, IV, 88–90; Julien, Trans. N. Y. Acad. Sci., III, 1883, 22–30; Brigham, Amer. Journ. Sci. 1895, Ser. III, XLIX, 213–228.

recession of the ice from this section of the State was much more complex than in the central and western portions; for, in addition to the moraines made by the great ice sheet, very much influenced by the rugged topography, and hence scattered and difficult to trace, there were no doubt local glaciers in the mountain valleys, as there are now in Greenland, and as there were at the close of the Glacial Period in New Hampshire and Maine. The mapping and correlation of these moraines is one of the important problems on the geology of New York and one that will do much to tell what the ice really did. Until such work has been done in New England and New York we will have but a meagre knowledge of the great American ice sheet.

OVERWASH PLAINS AND VALLEY TRAINS.—These have already been mentioned in the third article of this series* and can therefore be briefly dismissed here. Where the glacier front stood for a long enough time to build morainic hills, the floods of water, being commonly overburdened with sediment, built up deposits of stratified gravel on the southern side of the moraine. Where the topography was not rugged, numerous ice-derived streams built sloping plains resembling low alluvial fans. These are well seen on Long Island and Martha's Vineyard, and to those of the latter place Professor Shaler has given the very descriptive name of frontal aprons.† The plains on the southern slope of Long Island are of this origin, and they are often crossed by the channels of the streams that built them, though now at times no water flows in them.‡ Overwash plains, as these are also called, are not confined to this section, but in less perfect development are found every here and there on the southern side of the New York moraine, particularly in the south sloping valleys. The best instance with which I am familiar outside of Long Island is that upon which the town of Horseheads, north of Elmira, is situated.§

These plains often merge into valley trains of stratified drift. Practically all the south-sloping valleys of western New York have been embarrassed by these deposits,‖ which are sometimes very deep. The Susquehanna and its tributaries, even beyond the boundary of New York, contain deposits of this origin, so that now

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* Bull. Am. Geog. Soc., XXX, 1898, 42–44. See Salisbury, 1892 Report, New Jersey Geol. Survey, 96–125.

† Shaler, 9th Ann. Rept. U. S. Geol. Survey, 1889, 548.

‡ See references above to the Long Island moraine.

§ Fairchild, Bull. Geol. Soc. Amer., VI, 1895, 367.

‖ Brigham, Bull. Geol. Soc. Amer., VIII, 1897, 17–30.

this stream, as in the case of many others, is flowing high above the old rock bottom of the preglacial valley. By this means much of the glacial drift was removed well beyond the ice margin, and not a little of it reached to the sea. The stream valleys sloping away from the ice all show some effects of this flooding with sediment-laden glacial water. These deposits grow finer and finer as we proceed down stream, being coarse gravel near the moraines and oftentimes fine clay near the sea.

The surface of overwash plains, valley trains, moraines and sandplains (described just below) is often pitted with little kettle-shaped depressions.* These kettles are sometimes caused by irregularities of deposit, either through differences in supply of material, or in direction or form of currents which were swirling about, forming eddies here and there. In other cases, and perhaps the majority, the kettle has resulted from failure to deposit material, because that particular part of the surface was occupied by an ice fragment or stranded iceberg, which had stratified drift deposited all around it and finally over it, and then, melting away, left the material to settle down, forming a kettle hole. In the marginal lakes on the coast of Greenland instances of this may be seen; and it is probable that while the American ice sheet was melting away, the conditions favoring this mode of formation of basins were in operation.

LAKE DEPOSITS.—As will be shown in a later article under the discussion of the Great Lakes, during the retreat of the glacier many lakes were made in regions where now they are impossible. Then there were ice dams where now there is no barrier to the free northward flow of the rivers. As the ice front withdrew, passing north of the Allegany and Susquehanna-St. Lawrence divide, each of the valleys that sloped northward was dammed by the glacier, forming lakes in their southern ends, the area of which grew as the glacier front stood farther and farther north, until, finally, the withdrawal was sufficient to admit of a northern outflow, when the lake level fell. This distinct lake history by itself has been interesting, and is told by the deposits made during the time that the waters were thus ponded.†

Along these lake shores, beaches and bars were in some cases built, while deltas were very commonly formed at the mouths of

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* See references to Koons, p. 198, and Woodworth, Amer. Geol., 1893, XII, 279.

† Fairchild, Bull. Geol. Soc. Am., VI, 1895, 353–374; Lincoln, New York State Museum Report, XLVIII, Part 2, 1894, 74–77.

the tributary streams. These, however, are not strictly glacial deposits, though in cause intimately related to the glacier. But in the lakes, deposits of stratified drift were also made from material derived directly from the ice. As the streams emerged from the glacier into these lakes, they poured their volumes of sediment into the quiet lake waters, where it settled, the coarsest near the glacier, the finer farther away, forming there a layer of lake clay. This is especially well developed along the southern shores of Lakes Erie and Ontario, though not absent from the numerous smaller valleys of the Finger Lake region. To these were added deposits dropped from the glacier itself, and still others floated away into the lake, buoyed up by the tiny icebergs that must have floated away from the ice front.

These deposits have not notably modified the surface of New York, though they have added somewhat to the glacial modifications of the details of topography. Near the ice margin, at its various stands, deposits must have been rather extensively made near the mouths of the sub-glacial rivers. No doubt such deposits are common in portions of the State, though they have not been described from there. In New England they are found quite commonly, especially near the coast, where they are called sandplains.* These are really deltas in a body of water now absent. The material was supplied from the melting of the ice, and the form of the deposit is that of a true delta, flat-topped, with steep front, and traversed by stream channels, and sometimes pitted on the surface by kettles, probably formed by the same means as those mentioned above (page 206).† Future study will no doubt discover sandplains in New York.‡

KAMES.—Throughout New York, commonly in association with the moraines, but often isolated, are single hills, or groups of hummocky hills, of stratified drift called kames.§ In topographic form they resemble moraines and are often a part of these deposits; but elsewhere they seem to bear no relation to morainic bands. Single

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* There is reason for believing that some of the New England sandplains are really deltas formed in the sea when the land was somewhat lower than at present, as it was during the close of the Glacial Period. The evidence of this will be published in a forthcoming number of the American Geologist.

† For a discussion of sandplains see Davis, Bull. Geol. Soc. Am., I, 1890, 195–202; Davis, Proc. Boston Soc. Nat. Hist., 1892, XXV, 477–499; Gulliver, Journ. Geol., 1893, I, 803–812; Salisbury, Ann. Rep. New Jersey Geol. Survey, 1892, 99–102.

‡ Tarr, Bull. Am. Geog. Soc. XXX, 1898, 45.

§ Salisbury, Ann. Rep. N. J. Geol. Survey, 1891, 92–95; Same, 1892, 84–95.

hummocks may be found upon hillsides or even hilltops. They sometimes show a confused stratification with the layers dipping in various directions, and exceedingly variable in texture. Moreover, the layers are sometimes broken, showing disturbance subsequent to deposit. In different places their origin is apparently quite different. Glacial water has evidently made them; but there are various ways in which this water may construct hills of stratified drift. Deposits in caverns under the ice, hills made by cascades carrying much sediment down the ice front or through crevasses into the ice, and deposits in tiny lakes upon the surface of the glacier, and later lowered to the ground when the ice melted, are some of the more common ways in which kames may have been made. By this action hills several scores of feet in height have been constructed.

Naturally the conditions favoring such deposits will exist only near or at the ice margin; but as this front was in all parts of the State at different times, kames may be found in any part of New York, and indeed they do occur all over the State, sometimes rising in what appear to be the most unnatural positions. Where the ice stood longest they would be most abundant; and hence they are most common in association with the moraines. Slight forward movements of the ice would break and disturb the layers as we find them. Few specific cases of kames have been described in New York,* but they are known here and have also been described from various parts of the country.†

Eskers or Serpent Kames (Osars).—Ridges of gravel, bearing a close resemblance to embankments, are frequently found within the glacial area. In these the material is usually coarse. Sometimes they are made of good-sized and well-rounded pebbles, oftentimes several pounds in weight. Sometimes, however, eskers are made almost entirely of sand. The stratification, while often noticeable, is usually somewhat confused, and the ridge may be coarse in one place and much finer in another.

In the form of eskers there is much variation. Typically they are distinct, narrow-topped ridges, extending in a more or less irregular or serpentine course. Some are mere low banks; others

* See particularly Fairchild, Am. Geol. 1895, XVI, 39–51; Same, Journ. Geol. IV, 1896, 129–159; Brigham, Bull. Geol. Soc. America, VIII, 1897, 17–30; Lincoln, New York State Museum Report, XLVIII, Part 2, 1894, 72–74.

† For instance, see Upham, Hitchcock's Geol. of New Hampshire, Vol. III, 1878, 12–176; Lewis, Second Geol. Survey Pa. Rept. Z, 1884, 35–36; 61–65; 78–81; 100–111, etc.; Chamberlin, Journ. of Geol. 1893, I, 255–267.

have a height of several scores of feet. In some cases the crest of the ridge is level; but more commonly it undulates somewhat and has a gradual slope in one direction, normally sloping downward in the direction of ice movement as revealed by the striæ upon the bed rock. Variations from this normal form are common. At times the ridge is interrupted, or it may end abruptly, or even very gradually, often terminating in a broad, sandy area. Some eskers

FIG. 18.—SIDE VIEW OF ESKER, AUBURNDALE, MASS. (PHOTOGRAPH BY JOHN RITCHIE, JR.).

end in sandplains.* These ridges may even end in a tiny valley cut in the till.

As for location, they may be found anywhere within the glacial belt, though they are more common near the moraines. They are very abundant in eastern New England, and have been well described for the Boston region.† Among the mountains of Maine ‡ and New Hampshire § they are common. The term esker is an Irish name,‖ and these peculiar ridges are common in Ireland, as

* See Davis, Bull. Geol. Soc. Am. I, 1890, 195–202; Davis, Proc. Boston Soc. Nat. Hist., 1892, XXV, 477–499; and Gulliver, Journ. Geol. I, 1893, 803–812.

† Bouvé, Proc. Boston Soc. Nat. Hist., XXV, 1891–92, 173–182.

‡ Jackson, Geol. of Maine, 1st Rept., 1837, 64; Stone, Proc. Amer. Assoc. Adv. Sci., 1880, XXIX, 510–19.

§ Upham, Hitchcock's Geol. of New Hampshire, Vol. III, 1878, 12–176. For New Jersey eskers, see Salisbury 1892 Report New Jersey Geol. Survey, 79–83.

‖ Young, Report Brit. Assoc., 1852, XXII, Part 2, 63–64; Kinahan, Amer. Journ. Sci., 1887, Ser. III, XXXIII, 276–278.

elsewhere in the British Isles * and northwestern Europe. In Scandinavia they are called äsar (anglicized osars). Little work has been done upon the eskers of New York, though they occur in association with the moraine.† Instances of eskers may be seen near Freeville, New York, and along the Lehigh Valley Railway west of Geneva. In all probability they are common, particularly in the more hilly sections, such as the Adirondacks.

As for the details of location, eskers are very commonly found in valleys, but by no means confined to them. They have been found upon hillsides and are known to cross valleys, extending

FIG. 19.—CREST OF ESKER, AUBURNDALE, MASS. (PHOTOGRAPH BY JOHN RITCHIE, JR.).

down one side and up the other.‡ Such conditions are exceptional, and the type location may be said to be the valley, or else the immediate neighborhood of a moraine. Here they may be but a few score of yards long or may extend for miles. Some of the eskers of Maine are exceedingly long and well developed. When typically developed they have a remarkably artificial appearance, sometimes closely resembling an abandoned railway embankment. They have in some cases been explored in the belief that they were Indian mounds.

* Howe, Report Brit. Assoc., 1861, XXXI, Part 2, 115–6.

† Upham, Proc. Rochester Acad. Sci., II, 1893, 181–200; Fairchild, Journ. Geol., IV, 1896, 129–159.

‡ Shaler, Ninth Ann. Rept. U. S. Geol. Survey, 549.

Their form and characteristics point plainly to stream origin and to the conclusion that they are really the beds of glacial streams. There has been some question whether these glacial stream beds were formed under the ice (subglacial) or in the ice (englacial), or upon the ice (superglacial), and this question is still an open one.* The facts seen in living glaciers †, and those discovered by the study of existing esker deposits, point to a subglacial river origin as by far the most probable ‡, although other facts brought forward seem to show that there are some eskers which have been formed by superglacial or englacial streams.§

Near the ice front streams were flowing in each of these positions, but by far the greater amount of drainage near the ice terminus must have been subglacial. In either case the running water was supplied with much sediment which was being dragged along the stream bed. Wherever more was given than the stream could remove, deposits were necessarily made in the stream bed. Since the ice contained many pebbles and boulders, as well as finer clay, it would not uncommonly happen that the stream could not remove as much sediment as was given to it. Then, at the bottom of the ice cañon, an embankment of gravel would be built, held in by ice walls, and resting either upon the ice (in englacial or superglacial valleys), or on the ground if subglacial. When the ice withdrew, the stream deposits would settle, the sides taking the slope of gravel at rest ‖, but retaining the average slope of the stream bed (if this were on the ground) and its meandering direction. Therefore the esker represents a fossil glacial stream bed, whether subglacial or superglacial or englacial.

The confused stratification is due to the irregularity of deposit, later settling, and possibly to disturbances caused by ice movement. The interruption of form may be due to ice movement or to failure

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* Davis, Proc. Boston Soc. Nat. Hist., 1890–92, XXV, 477–499; Chamberlin, Journ. of Geol., 1893, 1, 255–267; Upham, Bull. Geol. Soc. Am., V, 1894, 71–84; Amer. Geol., 1894, XIV, 403–405; Winchell, Am. Journ. Sci., 1881, XXI, 358–60; Sollas, Report British Assoc., 1893, 63, 777; Russell, Am. Journ. Sci., 1892, Ser. III, XLIII, 178–182; Same, Thirteenth Ann. Rept. U. S. Geol. Survey, Part II, 81–82; Reid, 16th Rept., Part I, U. S. Geol. Survey, 442.

† Russell, Amer. Journ. Sci., 1892, Ser. III, XLIII, 178–182; Same, Thirteenth Ann. Rept. U. S. Geol. Survey, Part II, 81–82; Reid, 16th Rep., Part I, U. S. Geol. Survey, 442.

‡ Davis, Proc. Boston Soc. Nat. Hist., 1890–92, XXV, 477–499; Chamberlin, Journ. Geol., 1893, 1, 255–267.

§ Winchell, Amer. Journ. Sci., 1881, XXI, 358–60; Upham, Bull. Geol. Soc. Am., V, 1894, 71–84; Am. Geol., 1894, XIV, 403–405.

‖ Woodworth, Proc. Boston Soc. Nat. Hist., XXVI, 1895, 197–220.

to deposit in particular places; and the broadening out in places, from the ridge slope to the low sandy areas, may either represent the terminus of the esker stream, at the glacier margin, or some broad part of its ice-walled valley. The location of eskers upon hillsides may be easily accounted for. If formed on or in the ice, the valley location is essentially accidental; and when the ice disappears the eskers may settle upon the hillsides, as well as in a valley. If, on the other hand, as seems much more commonly, if not almost universally, the case, the esker stream was subglacial, the water building the esker was flowing in an ice channel under considerable pressure, so that it might even flow up hill, if the hill were not higher than the pressure head, for the same reason that water flows through the pipes to the second story of our houses. In this case the esker location would generally be along valleys, and this is the case.

THE TILL SHEET.—The material that was on, in, or under the ice (superglacial, englacial and subglacial till) at the time it melted away from any given place, was left upon the surface of the country

FIG. 20.—SECTION IN VERY BOULDERY MORAINIC TILL, CAPE ANN, MASS. (PHOTOGRAPH BY J. L. GARDNER 2ND).

as a till sheet, that part removed by water being of course excepted. This till sheet, which covers the greater part of New York, and particularly the hillsides and tops, varies greatly in character from place to place. Typically and prevailingly it is a *boulder clay*, which, as the name suggests, is essentially a boulder-bearing clay.

The percentage of boulders varies from nearly boulder free to a class of till in which more than one-half the mass is made of boulders. The clay is a rock flour made by the grinding of the rocks as they are dragged along by the ice; and this abrasion is further indicated by the fact that many of the boulders and pebbles are grooved and polished.

The color of the till sheet varies greatly, depending in large measure upon the color of the rocks over which it passed just before it was deposited. This indicates a rather local origin for much of the till; and this is borne out by the fact that among the boulders are found many of local origin. Still, in a region where the

FIG. 21.—BOULDER-STREWN SURFACE OF MORAINIC TILL, CAPE ANN, MASS. (PHOTOGRAPH BY J. L. GARDNER 2ND).

rocks are soft, as they are in the shale country of central New York, these fragments are worn so rapidly that they may be less numerous than the Canadian boulders and pebbles which, though brought from afar, being harder, have been better able to stand the long journey than the shale fragments were the much shorter one. The farmers have practically asserted this fact when they have called these foreign boulders, resting in the midst of soft shale strata, by the very descriptive name of "hardheads." In the region from which the hard heads have come boulders may be so common that, as in parts of New England, the soil is almost incapable of cultivation.

While the color of the drift is variable, its general color, when fresh and unoxidized, is blue, grading to a yellow near the surface where stained with the limonitic iron stain formed during oxidation of iron-bearing minerals. The blue color is due to the finely comminuted and undecayed dark particles, and may be present even when the till has been derived from light colored gneissic and granitic rocks.

Although typically a clay, the till is sometimes sandy, though not commonly. When very clayey it is often so compact that it is difficult to dig through it with a spade. This has been given the name of "hard pan," and it owes its compactness not merely to the fineness of the clay, but also, at times, to the fact that it has been pressed into a compact condition by the weight of the ice which once rested upon it.

The mode of origin of this till sheet was, first, the removal of loose fragments from the surface, then, with the aid of these, the grinding off of others, accompanied by the grinding of the various particles into finer bits. In position, while some of the fragments may have been upon the ice top, and some within the ice, the greater part was dragged along, either just beneath the ice, or frozen in the lower layers of the glacier. In Greenland the latter is the common mode of transportation of the *débris* load. This glacier has a smaller burden of rock fragments than the American glacier, and the till sheet which it is depositing is, therefore, much less developed. There is good reason for believing that some of the American till was dragged along beneath the ice, so that here, as in some other respects, the Greenland glacier of to-day is not a fair guide for conditions prevailing in America during the Glacial Period.

This rock load, wherever carried, was left upon the surface of the land with the retreat of the glacier. In examining the surface of a large area, like that of New York, we find that this till sheet varies greatly in depth. There are places where there is almost none except in the little depressions, and this is particularly the case among the high gneissic peaks of New England and the Adirondacks. This means either that none was deposited or else that it has been removed; and sometimes one explanation is correct, sometimes the other. This is the prevailing condition in Greenland, where the slopes are great and the original till deposit slight. Frequently the till is but a few inches or feet in depth, and then the rock is reached in ordinary trenches. This condition is most common upon hilltops or upon those hillsides where we may believe the

ice movement to have been relatively rapid. In such places little was left, because little was held under the ice, the movement being rapid enough to prevent such accumulations, somewhat as a river with rapid flow, during the time of flood, can clear its bed of the gravel-bars that were accumulated at some time of less rapid movement.

The thickness of the till sheet varies progressively also over wide areas. As a general statement, subject to many modifications locally, the till sheet of New England and eastern New York is thinner than that of western New York, and this is thinner than that of the Central States, where it is sometimes two or three hundred feet deep.* This general change in thickness is parallel with a change in topography from mountain to hill and then to plain. Over the latter the ice slope was slight and the current probably less rapid than in the more irregular regions of the east. The variation is also parallel with a change in rock texture. In the east the strata are prevailingly hard; in the west relatively soft, although of course to this there are certain local exceptions. From a region of soft rock more drift is supplied than from one of hard, and this is one of the reasons why the Greenland glacier has so little drift. It follows from this that in the central west the ice wrested more drift and was less able to remove even a small supply than in the east. Hence beneath the ice much till was accumulated in the western section, while in the east the opposite holds true, as a general statement.

As has been said, this general statement needs modification locally. Among the Adirondacks, and in New England, the ice currents were often retarded by some rocky hill, around which the ice must flow. Upon the southern or lee side of such a hill the conditions favored deposits beneath the ice; and consequently, while the north side of such hills is nearly bare of drift, the southern side often has a deep till soil. Here very often the rocky hill has been prolonged southward as a drift hill formed by the deposit of a tail of drift upon which, very likely, a farm is situated, while all around is untillable and hence wooded land. This drift material, combed down from the hilltop and sides, and accumulated in the slack ice current on the lee side of the hill, forms a distinct element in the landscape of many of the hilly sections.

Still another case may be introduced. Rather narrow east-west valleys extended across the course of the south-moving glacier, as

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* Calvin, Amer. Geol., I, 1888, 28–31; Leverett, Am. Geol., IV, 1889, 6–21; Claypole, Bull. Geol. Soc. Am., III, 1892, 150–151.

was very commonly the case in central and western New York. Down into these the ice currents could not move as readily as along the hilltops, and hence here too, material from the hilltops was combed off and dragged beneath the ice into the valleys. The result

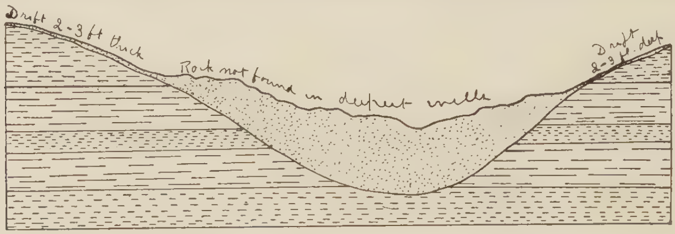


FIG. 22.—SECTION TO SHOW DEEP DRIFT FILLING IN NARROW EAST-WEST VALLEYS NEAR ITHACA, N. Y.

has been that in such valleys the till is deep, gradually becoming thinner upon the hillsides. The diagram is based upon these conditions as exhibited in scores of places near Ithaca, N. Y. In these cases the valley has been made more shallow and its bottom broader than before the ice came, and by these causes the topography of the New York-Pennsylvania plateau has been greatly modified.

Not only have valleys been shallowed, but in some cases they have been entirely obliterated. Near Ithaca there are numerous

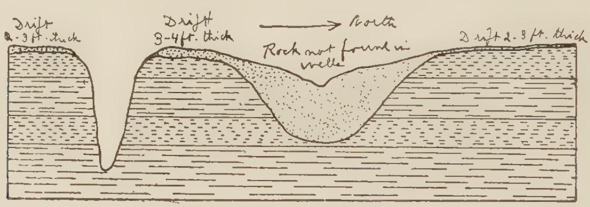


FIG. 23.—SECTION TO SHOW BURIED VALLEY OF TAUGHANNOCK CREEK, NEAR CAYUGA LAKE, N. Y.

buried valleys, the position of some of which is not now indicated in the landscape, while that of others is shown by a gentle sag in the hillside. The diagram (Fig. 23) is based upon these conditions now to be found just north of Taughannock gorge on the west side of Lake Cayuga, a few miles north of Ithaca. Where the general drift sheet is thick, and the original topography less irregular, as in the central west (and apparently also in the Ontario region*), the preglacial drainage lines are almost entirely obliterated. By boring for oil, some of them have been discovered, where, without the

* See article III of this series, Bull. Amer. Geog. Soc. XXX, 1898, 52–54.

facts thus obtained, the extent of the preglacial land irregularities would not be known.*

There are several other causes for irregularity in the depth of the till sheet, the exact causes of which are not apparent. Sometimes the till is locally thicker than elsewhere without any evident relationship to the topography. Its surface rises and falls in gentle swells, or rises into hummocks or ridges. This irregularity has led Professor Chamberlin † to suggest certain names, such as mammillary hills, till tumuli, etc., to designate the several types. Nothing more can now be said about the cause for these than that they must be related either to some unusual variations in supply, or in ice currents, or be due to the influence of minor topographic features, the nature and extent of which is not always easy to determine. They fall among the category of the altogether too numerous instances of unexplained glacial phenomena. We need specific studies of these forms and the collection of facts concerning them.

DRUMLINS.—Among the irregularities of the till none form such a striking element of the topography as those till hills which are classed as drumlins. These were first fully described in Ireland, whence their name.‡ In this country they occur in eastern Massachusetts§ and southern Connecticut, as well as in other parts of New England.‖ They occur also in Wisconsin.** Generally they are found in clusters, though many isolated drumlins are known. These peculiar hills are said to occur in the Adirondacks and in eastern New York,†† though I find no description of these localities; but one of the most notable accumulations of drumlins in the world exists

* Newberry, Geol. Survey Ohio, 1869, 24–33; Andrews, 60–64; Newberry, Geol. Survey Ohio, Vol. I, 1873, 85–88; 174–184; Orton, 425–434; 438–449; 455–462; Gilbert, 537–556, and other parts of Report.

† Chamberlin, Third Annual Rept. U. S. Geol. Survey, 1883, 296–309; Compte Rendu, Congrès Géol. Inter. Washington, 1891, 176–192; Journ. of Geol. 1894, II, 517–538.

‡ Kinahan and Close. General Glaciation of Iar-Connaught, Dublin, 1872.

§ Shaler, Proc. Boston Soc. Nat. Hist., XIII, 1869–1871, 196–204; Upham, Proc. Boston Soc. Nat. Hist., XX, 1878–80, 220–234; Marbut & Woodworth, 17th Annual Rept. U. S. Geol. Survey, Part I, 995; Davis, Science, IV, 1884, 418–20; Amer. Journ. Sci., 1884, XXVIII, Ser. III, 407–16.

‖ Hitchcock, Proc. Boston Soc. Nat. Hist., 1876–78, XIX, 63–67; Upham, Hitchcock's Geol. of New Hamp., Vol. III, 1878, 287–309; Hitchcock, 309; Upham, Proc. Amer. Assoc. Adv. Sci., 1879, XXVIII, 309.

** Chamberlin, Journ. Geol., 1893, I, 255–267; Upham, Am. Geol. 1894, XIV, 69–83.

†† Upham, Bull. Geol. Soc. Am., III, 1892, 142.

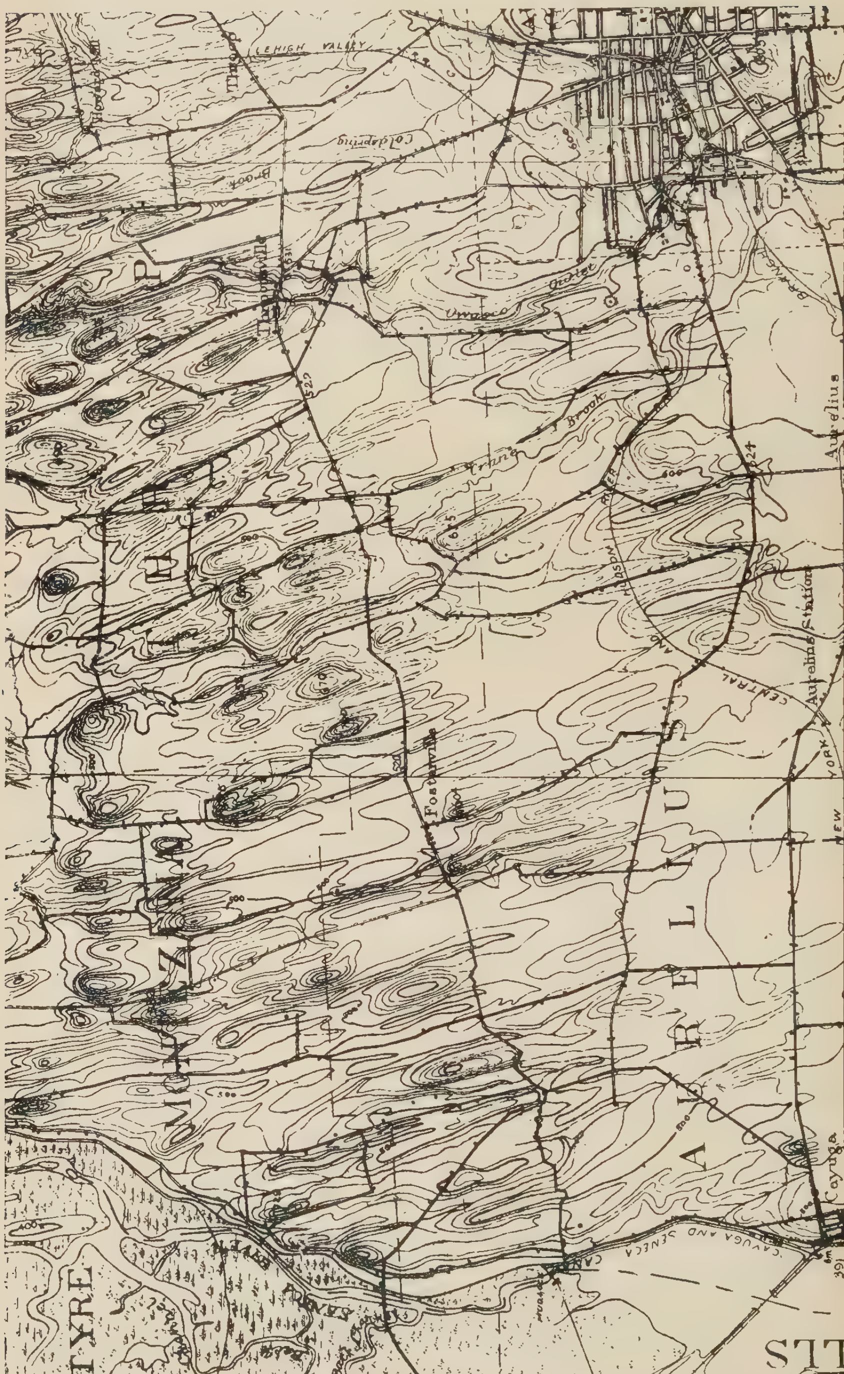


FIG. 24.—A PART OF THE DRUMLIN REGION NORTH OF CAYUGA LAKE (U. S. GEOL. SURVEY TOPOGRAPHIC MAP).

in the region between Syracuse and Rochester along the line of the New York Central Railway. As in the case of most of the other glacial features of New York, we have no adequate description of these interesting hills.*

The New England drumlin is typically a beautiful and symmetrical hill, elongated in form, having a shape resembling that of an egg when half submerged in water, with the long axis parallel to

FIG. 25.—A TYPICAL NEW ENGLAND DRUMLIN NEAR IPSWICH, MASS. (PHOTOGRAPH BY J. L. GARDNER 2ND).

the water surface. The length may be a half to three-quarters of a mile, the width a fifth to a half a mile at the base, and the height perhaps one to two hundred feet. There are longer and shorter, broader and narrower, and higher and lower forms than this type. The curves are wonderfully regular, but commonly the northern end is steeper than the southern. This type is well illustrated by scores of hills in Boston harbor, and near Boston, especially north of that city as far as the Ipswich coast. The long axis of the New England drumlin is parallel to the direction of ice movement, and the material of which they are composed is mainly till, though very often they contain stratified drift.† The Wisconsin drumlin is

* Hall, Geol. of N. Y. 4th Dist. 1843, 341; Johnson, Ann. N. Y. Acad. Sci., II, 1882, 249–66; Abstract in Trans. N. Y. Acad. Sci., 1882, I, 77–80; Davis, Science, IV, 1884, 419; Lincoln; Am. Journ. Sci., XLIV, 1892, 290–301; New York State Museum Report, XLVIII, Part 2, 1894, 69–71.

† Upham, Proc. Bost. Soc. Nat. Hist., XX, 1878–80, 220–234; Same, XXIV, 1888–89, 127–141; Same, XXIV, 1888–89, 228–242; Same, Amer. Journ. Sci., 1889, Ser. III, XXXVII, 359–372; Crosby & Ballard, Amer. Journ. Sci., 1894, Ser. III, XLVIII, 486–496; Marbut and Woodworth, 17th Annual Rept. U. S. Geol. Survey, Part I, 995; Upham, Amer. Geol. XX, 1897, 383–387.

often much shorter and less symmetrical,* the Irish type much longer.†

The drumlins of central New York approach the Irish type much more closely than those of New England. Their form varies from the southern margin to the northern. In the latter part of the belt, they are often very much like the Boston type, though considerably less symmetrical and with steep northern faces. Near the southern margin of the drumlin belt they are exceedingly long and low ridges, the length being sometimes more than two miles and the height very often less than one hundred feet at the highest point, which is close to the northern end. Some ridges, perhaps three-quarters of

FIG. 26.—LOW DRUMLIN RIDGE NEAR SOUTHERN MARGIN OF NEW YORK DRUMLIN AREA, JUST EAST OF CAYUGA (PHOTOGRAPH BY W. B. GREENLEE).

a mile long, are not more than forty feet high at the highest point. In fact, these low drumlins simulate the esker in form. Even many of the higher drumlins of this section change to low and long ridges in the southern part, and their exact southern terminus is often incapable of location, for it flattens out into the undulating till sheet very gradually. Sometimes this terminus is in the irregular morainic topography. In all cases the northern end is well defined and relatively steep.

While some of the drumlins are long and low, with an even-topped crest line, sloping gradually southward, others have an undulating crest, giving a very ragged sky line. Whether this is a part of the original form of the drumlin, or has been caused by later

* Chamberlin, Geol. Survey, Wisconsin, I, 1873–79, 283.

† Kinahan and Close, General Glaciation of Iar-Connaught, Dublin, 1872.

denudation has not been determined, though there are some reasons for supposing that the latter is true.

Between the long and low type at the southern margin of the belt, and the shorter type at the northern margin there is a grada-

FIG. 27.—THE NORTHERN ENDS OF THREE OF THE NEW YORK DRUMLINS NEAR MONTEZUMA (PHOTOGRAPH BY W. B. GREENLEE).

tional form to which a student of Cornell University applied the descriptive name of "tadpole" drumlin. The northern end of such a drumlin resembles the northern type quite closely, while the southern end is a low ridge, and the two different parts are connected by a rather noticeable slope, somewhat like the southern

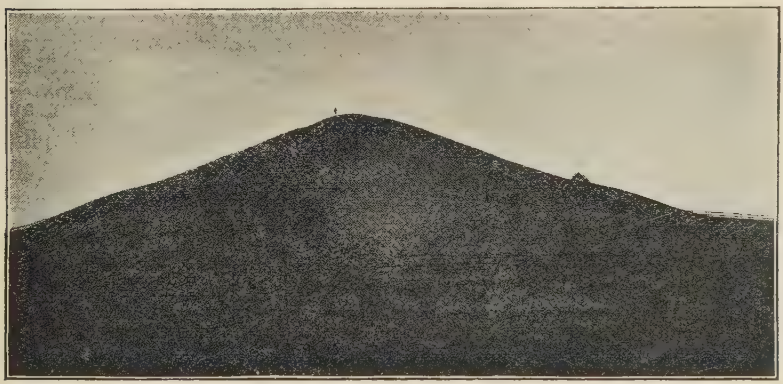

FIG. 28.—NORTHERN END OF A HIGH DRUMLIN AT MONTEZUMA, N. Y. (PHOTOGRAPH BY W. B. GREENLEE).

end of a New England drumlin. Hence the drumlinoid form, somewhat closely resembling the typical New England drumlin, quickly changes to a low and long ridge, causing a rather remarkably close resemblance to a tadpole body with the appended tail. Some of the New York drumlins are quite like the New England type in

form, and all so far studied are made of unstratified till. The question of the nature and origin of these drumlins is now under investigation, and it is probable that the intermediate "tadpole" forms will throw light upon the question of drumlin origin.

As in the case of all drumlins, the long axis is parallel to the direction of ice movement, which, in this section, was approximately southward. The material composing them seems to be till

FIG. 29.—RIDGE-LIKE DRUMLIN, NEAR MONTEZUMA, N. Y., SHOWING NORTHERN END ON LEFT (PHOTOGRAPH BY J. O. MARTIN).

of the normal kind, perhaps somewhat more pebbly than commonly; but upon this point definite statements cannot be made until further studies have been carried on. Nor can we say how many drumlins there are, though it is certain that there are many hundreds in this area; and one may stand upon the crest of one and count scores which stand in plain view with their ends overlapping. The topography of the drumlin region is quite unique in New York State, and has probably given rise to more inquiries from residents than has any other section of the State of equal population. Every year several students ask me for the interpretation of this region, a fact true of no other part of the State.

The origin of drumlins is still an open question, or at least should be, though there is a tendency on the part of some to consider it settled. Numerous theories for their origin have been suggested,*

* See preceding references, and also Wright, Ice Age in North America, 251–267; Geikie, Great Ice Ace, 3rd Ed., 743–745; Russell, Glaciers of North America, 24–28; Geikie, Geol. Soc., Glasgow, 1867, Vol. III, 54; Wright, Proc. Boston Soc. Nat. Hist. XIX, 1876–78, 58; Salisbury, Ann. Rept. N. J. Geol. Survey, 1891, 71–75; Upham, Am. Geol., 1892, X, 339–362; Upham Am. Geol., 1895, XV, 194; Russell, Journ. of Geol., 1895, III, 831; Upham, Bull. Geol. Soc. Am., VII, 1896, 17–30; Tarr, Am. Geol., 1894, XIII, 393–407. In the latter, I have attempted to consider the two theories fairly, and have advocated the reopening of the question of origin.

two of which still seem probable, while against the others numerous facts can be brought. One of these theories is that drumlins have been caused by erosion, resulting from slightly different ice currents; the other, and more generally accepted theory, is that they have been *built* by irregular deposit from the ice, somewhat as sandbars are built in rivers. The latter has more supporters than the former; but the question can hardly be considered closed, since no facts of importance have been brought forward to disprove the former. So far the theories have been stated as conceptions of the process which probably formed the hills. Careful studies of drumlin areas are now needed to test these theories, especially since there are facts difficult to explain upon the basis of the theory of construction which has so many adherents.

Glacial Erosion.—That the ice eroded is proved by the fact that it was able to deposit; for it must have obtained what it deposited, together with that which went off in the water furnished by ice melting. It is further proved by the scratched stones and the glacial scratches upon the ledges; but *how much* it eroded is more difficult to prove. The old notion was that ice performed wonderful tasks and greatly modified the topography as a result of this. From this extreme view there has been a reaction, and opinion has perhaps become nearly as extreme in the other direction, for there are those who deny to ice the power to do much work of this kind. That it did not erode enough to materially modify the surface in a *great* way, seems evident from an examination of the topography on the two sides of the extreme terminal moraine. Careful observation is necessary to detect the differences, which would not be the case had the ice scoured greatly in the glaciated district.

One thing every one will admit is, that in most places the ice removed the loose *débris* that had accumulated in preglacial times; still there are places in New England, and probably also in New York, where this was not done. This also argues against extreme glacial erosion; but these facts may be admitted without necessitating the view that erosion was everywhere slight.*

All facts, as I see them, indicate marked difference in power of erosion in different places. The hilltops were scoured more than the east-west valleys, and in all probability the hilltops of central and western New York were perceptibly lowered by ice-scouring. The proof of this would be difficult, for we know absolutely nothing of the detailed conditions before the ice came.

* See Lincoln Proc. Am. Assoc. Adv. Sci., 1893, XLII, 177–8; Same, Am. Journ. Sci., Ser. III, 1892, XLIV, 290–301; Same, 1894, XLVII, 105–113.

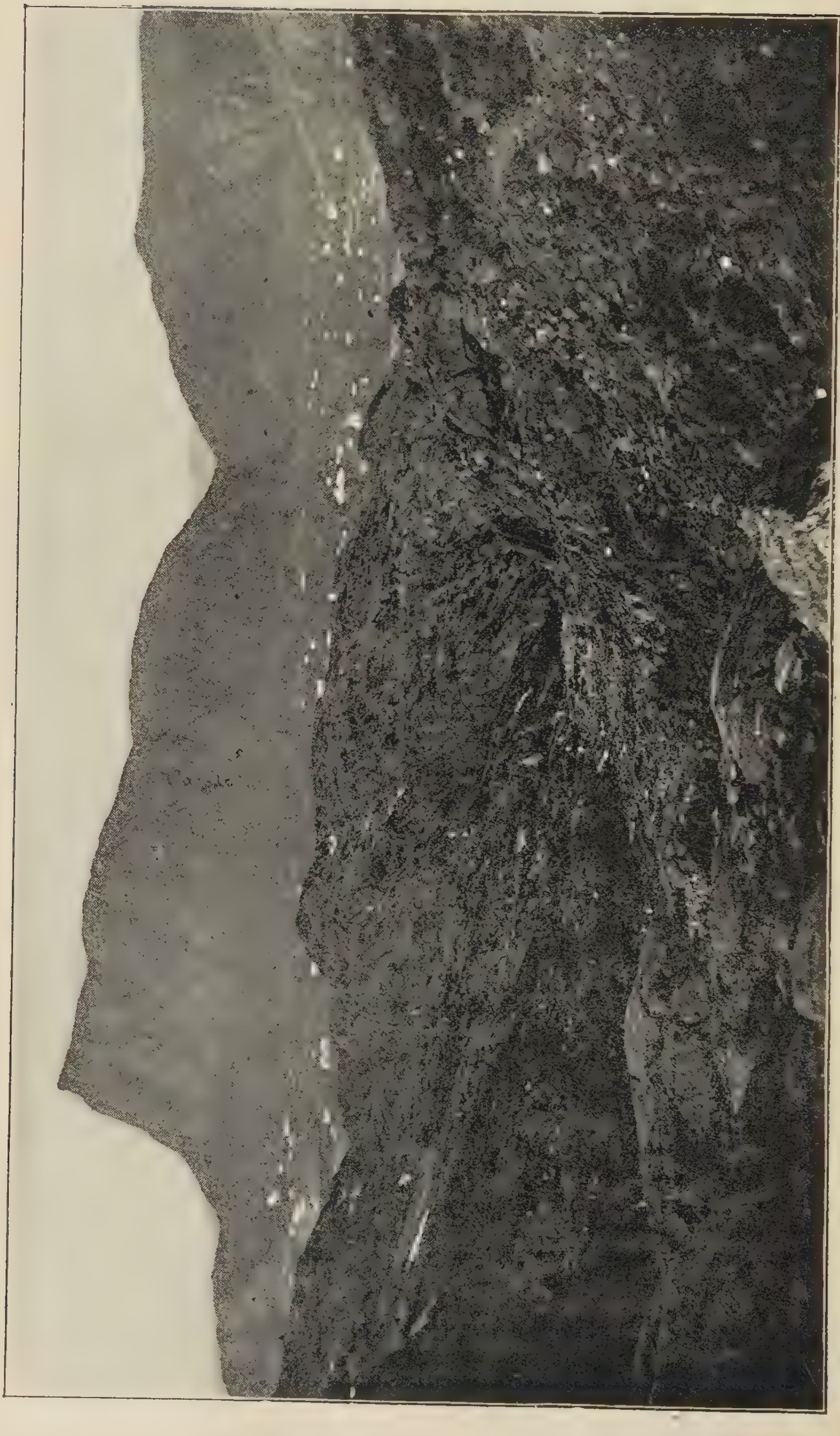

FIG. 30.—GLACIATED SURFACE OF UPPER NUGSUAK PENINSULA, GREENLAND, SHOWING SMOOTHED NORTH SIDE AND STEEP SOUTH SIDE OF A HILL CALLED THE DEVIL'S THUMB ON THE DANISH MAP (PHOTOGRAPH BY L. C. MARTIN).

East-west valleys of narrow width, being transverse to the ice direction, were probably less eroded; but broad north and south valleys, like those of the Finger Lakes,* furnishing free passage to the ice, were perceptibly lowered and broadened. In such places I believe that we find the maximum ice erosion. It is in broad valleys extending in the direction of the ice movement that we find the most rapid ice movement, and hence erosion, at the margin of the existing Greenland glaciers. This is true not merely because of the breadth, but because the ice was deep in these valleys, and had a free and hence more rapid movement. These facts would seem to be sufficient proof of this view.

There was also more rapid erosion upon the north or *stoss* side of hills than upon the southern or *lee* side, against which the ice-currents had little chance to scour. That this is so is amply proved by the topography of New York and other regions, where the northern slope of hills is prevailingly more regular and rounded than the southern sides. The differences may amount to a difference between an inaccessible precipice on the southern and a gentle slope on the northern side of hills. This is beautifully shown in the Adirondacks, as it is also in New Hampshire and Maine, as well as in Greenland, where the ice has just left the land.

Therefore, it seems that by erosion the hilltops have been slightly lowered and rounded, hill-slopes modified and rounded upon the northern or stoss end, and broad valleys parallel to the direction of ice movement both broadened and deepened. If it were necessary ample proof of this position could be brought forward. This is a belief in moderate but irregular erosion, by which the topography of the State has been perceptibly modified in details; but to *just* what extent this modification has operated, how much the hills have been lowered and rounded and the valleys deepened, may never be determined.

Effect upon Drainage.—Of all the effects of the glacier this is probably the most notable. Lakes have been formed and allowed to disappear. Others now existing have been caused by one or another of the effects of the glacier. Streams have been turned temporarily across divides and others given permanently to different streams, while many have been turned either partly or wholly out of their old valleys. The drainage of New York is the complex result of preglacial topography and glacial modification. The consideration of this important effect of the ice must be left for later parts of this series.

* This question will be discussed much more fully in a later number of this series.

GEOGRAPHY OF THE LAURENTIAN BASIN.

BY

ISRAEL C. RUSSELL.

The region surrounding the Laurentian Lakes, or Great Lakes as they are more commonly termed, is of low relief. No mountains, unless the Adirondack Hills be dignified by that name, rise within its borders, and no summit furnishes sufficiently commanding views to enable one to judge of the relations of the topographical details throughout any considerable portion of that area. The geographical history of the region has to be patiently compiled from the reports of numerous observers who have explored the land and sounded the waters. The difficulties encountered in deciphering the records of past changes, on account of the low relief, are enhanced by the general covering of vegetation.

Before attempting to review the leading features in the geographical history of the region to which attention is here invited, it is important that we should have in mind certain facts respecting the lakes themselves as they exist to-day. In order to present some of these data in convenient form, the following table, compiled principally from the reports of the U. S. Lake Survey, is inserted:

LAURENTIAN LAKES.

| NAMES OF WATER AREAS. | AREAS IN SQUARE MILES. | | | MEASURES IN FEET. | | | |
|---|---|---|---|---|---|---|---|
| | WATER SURFACE. | WATER-SHED. | HYDRO-GRAPHIC BASIN. | MEAN ELEVATION. | MEAN DEPTH. | MAXIMUM DEPTH. | DEPTH BELOW SEA-LEVEL. |
| Lake Superior | 31,506 | 51,600 | 83,106 | 602 | 475 | 1,008 | 406 |
| St. Mary's River | 150 | 800 | 950 | ... | ... | ... | ... |
| Lake Michigan | 22,450 | 37,700 | 60,150 | 581 | 325 | 870 | 289 |
| Lake Huron | 23,800 | 31,700 | 55,500 | 581 | 250 | 730 | 149 |
| St. Clair River | 25 | 3,800 | 3,825 | ... | ... | ... | ... |
| Lake St. Clair | 410 | 3,400 | 3,810 | ... | ... | ... | ... |
| Detroit River | 25 | 1,200 | 1,225 | ... | ... | ... | ... |
| Lake Erie | 9,960 | 22,700 | 32,660 | 573 | 70 | 210 | ... |
| Niagara River | 15 | 300 | 315 | ... | ... | ... | ... |
| Lake Ontario | 7,240 | 21,600 | 28,840 | 247 | 300 | 738 | 491 |
| Total | 95,581 | 174,800 | 270,381 | ... | ... | ... | ... |

As may be seen from this table, the lakes are of broad extent in reference to the area of the hydrographic basin in which they are situated. The ratio of lake surface to water-shed is as 1 to 1.82. It has been found that the depth of water removed from the lakes each year by evaporation is in the neighborhood of 30 inches, or nearly equivalent to the direct contribution from the clouds—the average annual precipitation being about 35 inches. The discharge through the St. Lawrence, therefore, represents approximately the excess of rainfall over evaporation from the land area draining to it.

The water discharged by the several lakes, is as follows:*

| | | | |
|---|---|---|---|
| St. Mary's River, outlet of Lake Superior | 86,000 | cu. ft. | per second. |
| St. Clair River, outlet of Lakes Michigan and Huron | 235,000 | " | " |
| Niagara River, outlet of Lake Erie | 265,000 | " | " |
| St. Lawrence River, outlet of Lake Ontario | 300,000 | " | " |

The combined volume of water in the Laurentian Lakes is 6,000 cubic miles, or sufficient to maintain Niagara Falls for 100 years.

Such are some of the leading facts in the physical geography of the Laurentian Lakes as they have existed since first known to white men. Much evidence has been obtained in reference to the manner in which these conditions have been brought about, and it has been found that the Laurentian basin has a long and remarkably varied history. This geographical history may for convenience be divided into three portions—ancient, mediæval and modern—in much the same way that human history is thus divided. The first division embraces the vast lapse of time preceding the Glacial epoch, during which the region under consideration was a land area; the second division includes the time from the first invasion of the Laurentian Basin by the ice of the Glacial epoch to the stage in the retreat of the ice when it began to be permanently uncovered; and in the third division are placed the changes that have occurred since the last ice sheet withdrew from the southern margin of the region now draining to the Great Lakes.

*The Lake Region in Pre-Glacial Time.*—The hydrographic basin of the St. Lawrence, in common with a vast area surrounding it, is almost everywhere covered by a sheet of unconsolidated gravel, clay, etc., of glacial origin, as will be more fully explained in ad-

* L. Y. Schermerhorn, "Physical Features of the Northern and Northwestern Lakes," in American Journal of Science, 3d Series, Vol. 33, 1887, pp. 278–284.

vance. The thickness of this covering varies from a few feet to one hundred or even a hundred and fifty or more feet. About the immediate borders of the present Great Lakes there is a belt of country, in several places from twenty to forty miles broad, which was formerly occupied by the lakes when more widely expanded in certain directions than now, and became covered with stratified clays and sands, which were spread out at the bottoms of the old water bodies. The depth of this covering is frequently from forty to sixty feet, but its maximum thickness is unknown.

The superficial deposits just referred to conceal by far the greater portion of the underlying hard-rock topography, as it may be conveniently termed. Could this covering be stripped off, the surfaces of the rocks beneath would reveal the broader features, and in many instances the smaller valleys, hills and ridges which gave expression to the land before the coming of the glaciers. This buried surface of hard rock, consisting mostly of sandstone, shale and limestone, retains to a considerable extent the topographic features that resulted from erosion previous to the Glacial epoch, and furnishes evidence as to the changes which inscribed their records on the surface of the land in pre-glacial time.

In places the hard rocks project above the mantle of superficial material spread over them, and at other localities streams have cut down their channels through the surface layer so as to expose the rocks beneath. Then, too, hundreds of borings made in quest of coal, oil, gas, water, salt, etc., furnish valuable information concerning the depth of the superficial covering, and consequently in reference to the shape of the surface on which it rests.

The bold escarpment of limestone with shale beneath, which occurs adjacent to the southern shore of Lake Ontario, and a similar line of cliffs along the south side of Lake Erie, are remnants of topographic forms that existed previous to the Glacial epoch. The faces and edges of these escarpments are smoothed and striated in such a manner as to show that they offered stubborn resistance to the ice currents which came against them from the north. Other ridges and hills on the border of Lake Superior furnish additional data of the same nature. Some knowledge is thus had concerning the bolder topographic features of the Lake Region during the earlier portion of its history. Many of the wells that have been drilled through the sheet of surface material reveal the presence of narrow cañon-like channels and valleys in the hard rock beneath, where the present surface shows only a plain or a gently undulating surface. Sufficient evidence of the nature just

indicated has been obtained to show that the land in the Lake Region previous to the Glacial epoch was of mild relief, but had been eroded by streams into a system of broad valleys now occupied in part by the Great Lakes, to which many deep, narrow stream-cut channels conducted the waters falling on the adjacent uplands. In brief, the land was not only well drained, but presented the characteristic features of old topography. Throughout much, and probably the whole of the Laurentian Basin, at the time referred to, the relief was similar to that characteristic of a certain portion of the upper Mississippi Basin at the present day, where broad, nearly flat-bottomed valleys, bordered by bold rock-escarpments, intervene between rolling but well-drained uplands. In fact, in what is known as the "driftless area" in Wisconsin and Minnesota, embracing some 10,000 square miles, we have a remnant of pre-glacial topography not modified by ice action.

The length of time to which the land was subjected to weathering and erosion previous to the Glacial epoch cannot be measured in years, but was surely great. This is shown not only by the topographic forms produced by the slowly-acting erosive-agencies, but by the absence of rocks of late geological age. With the exception of a partial submergence of its extreme western portion during Cretaceous time, the entire Lake Region has been a land area since the Coal period. During this vast interval embracing probably a third or a fourth of the time included in what may be termed authentic geological history, the Lake Region in common with probably the whole of North America enjoyed a mild if not a sub-tropical climate and was clothed with luxuriant forests, including palms, and was inhabited by a long succession of strange reptiles and mammals all of which are now extinct.

Of this ancient history of the Lake Region, the only immediate records available are furnished by the hard-rock topography. Sediments of Tertiary lakes, like those in the far West in which so much evidence has been found bearing on the climatic condition of America in later geological time and on previous faunas and floras, are absent in the country drained by the St. Lawrence.

*The Lake Region during Glacial Times.*—The fair picture of broad valleys, bordered by stream-sculptured uplands and clothed throughout with forests comparable with those of the virgin lands of the Gulf States, presented by the Lake Region in late Tertiary time, was blotted out owing to a climatic change which caused glaciers of vast extent to flow from the north and cover it. The previous almost tropical luxuriance was replaced by desolation like that which

reigns at the present day in central Greenland. An ice sheet many hundreds of feet in thickness overspread the land and reached as far south as Cincinnati and central Kansas. A change to milder climatic conditions caused this first ice sheet to retreat, probably to the north of the site of the present Great Lakes, but evidence as to the full extent of this recession is lacking. As is well known, another ice advance followed the first stage of retreat, or the first interglacial stage, as it is termed. Succeeding this second advance, came another retreat and then a third advance. Each southward movement of the ice caused the entire Laurentian basin to be covered.

The condition of the basins of the Great Lakes during the interglacial stages of warm climate, is not fully known for the reason that subsequent ice advances, in each instance, blotted out such records as may have been made. In one locality, however, on the north shore of Lake Ontario, near Toronto, there are stratified lacustral clays, containing shells of fresh-water mollusks, insects and plant remains, which are covered by glacial clays. These records show that during one of the latest-interglacial stages, the basin of Lake Ontario was free of ice and occupied by a lake. The vegetation clothing the northern shore of this lake included species now growing in New York and Pennsylvania.

With the final retreat of the glacial ice from the Laurentian basin, what may be termed its modern history began.

*The Lake Region in Post-Glacial Time.*—As stated above, the ice sheet which covered northeastern North America during its last advance, had its southern margin to the south of the southern border of the present hydrographic basin of the St. Lawrence. To the south of the ice sheet the stream formed by its melting had an unobstructed flow southward. As the ice front retreated, however, there came a time when it withdrew to the north of the height-of-land now parting the streams flowing northward to Lake Erie, from those flowing southward to the Ohio and the Mississippi. This divide is an irregular east and west line; the southern border of the ice sheet was also an irregular east and west line. As the ice front receded, the divide was not uncovered all at once, but gradually, and lakes were found in the southern prolongation of the Laurentian basin from which the glacial ice was first melted.

Probably the first of these lakes to come into existence occupied the western end of the Erie basin, and overflowed southward through a channel beginning where Fort Wayne, Indiana, is now situated, and leading to the Mississippi. This lake has been named Lake Maumee, for the reason that a large portion of its basin is now

drained by Maumee River. It was small at first, but gradually broadened with the recession of the ice which formed its northeastern shore. One stage in its existence is shown on the accompanying sketch map, forming Fig. 1. The river which flowed from Lake Maumee was a mile wide, and the channel it carved is now occupied in part by the Wabash.


FIG. 1.—LAKES MAUMEE, CHICAGO AND DULUTH (REDRAWN FROM A MAP BY F. B. TAYLOR).

Soon after Lake Maumee came into existence, as has been shown by F. B. Taylor, C. R. Dryer and others, similar lakes were born at the south end of the Michigan basin and at the west end of the Superior basin. These lakes and the rivers that drained them are also represented on the map reproduced above. The three lakes thus far considered, were independent of each other, and were situated at different levels and all discharged southward to the Mississippi.

The ice front continuing to recede, there came a time when land to the northwest of the site of Detroit was uncovered, and an out-

let for the waters of Lake Maumee, lower than the Fort Wayne outlet, became available. Lake Maumee then discharged to Lake Chicago, across southern Michigan, and its water surface fell about

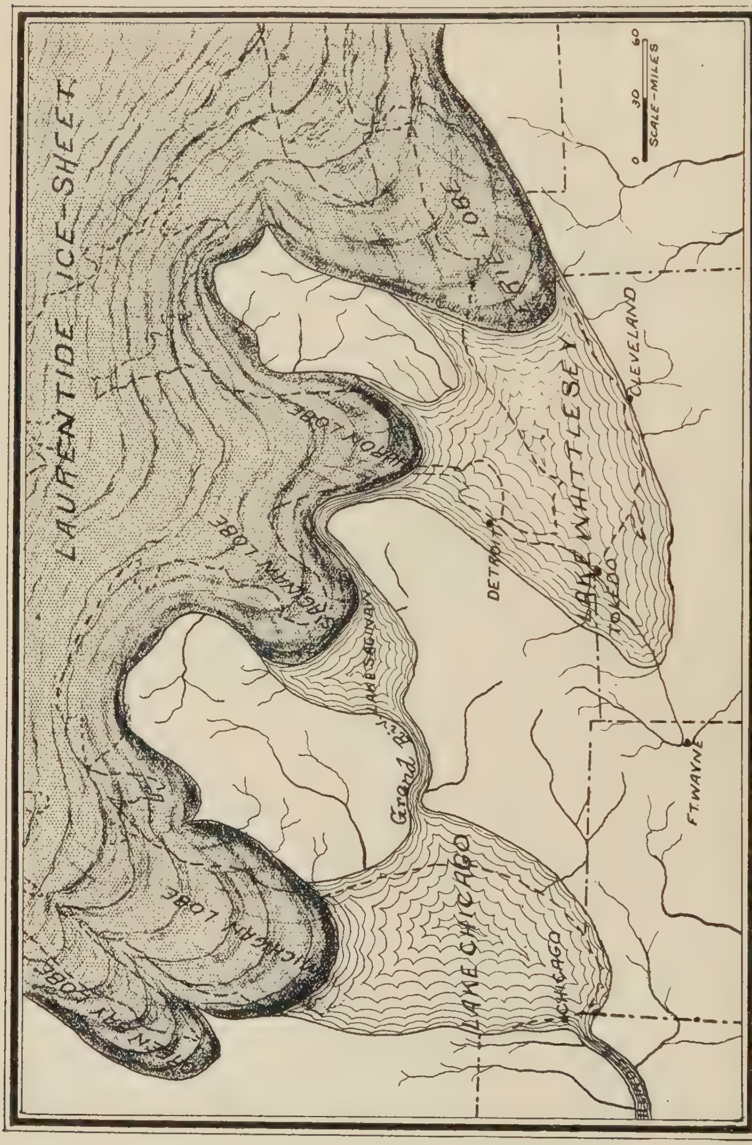


FIG. 2.—LAKES WHITTLESEY, SAGINAW AND CHICAGO (REDRAWN FROM A MAP BY F. B. TAYLOR).

twenty-five feet. After this change the water-body in the western end of the Erie basin was greatly changed, and became essentially

a new lake. The recession of the ice northward allowed the waters to expand, and a still lower outlet across Michigan was uncovered. For this stage in the condition of the water-body in the western parts of the Erie basin the name Lake Whittlesey has been given, as shown on the map forming Fig. 2.

At this time Lake Chicago was also much enlarged, although still discharging across its southern rim through the broad channel now occupied in part by Des Plaines and Illinois rivers. Another marginal lake existed at this time in Saginaw valley.

As has been described by Taylor, at the next step in the retreat of the ice front, Lake Whittlesey fell and blended with Lake Saginaw. This new combination is called Lake Warren. The outlines of this lake also slowly changed with the recession of the ice, and at one stage had the general characteristics shown in the map forming Fig. 3. Many other modifications occurred in the lakes held in by the glacial dams, but it is not possible to follow these minor changes at this time.


FIG. 3.—LAKES CHICAGO AND WARREN: OUTLET AT CHICAGO (MAP BY F. B. TAYLOR). *

At a considerably later stage in the retreat of the ice, the Mohawk valley in New York became uncovered, and the great lake formed by the expansion of several water-bodies like those briefly described above, found an outlet through the Mohawk-Hudson valley and the former outlet at Chicago was abandoned. As stated by Taylor, the discharge of Lake Warren then turned eastward and the

* The name *Labrador ice-sheet* used in this map is synonymous with *Laurentide ice-sheet* on accompanying map.

level of the waters fell so as to uncover the land between Lake Huron and Lake Erie. Across this area, now included in Ontario, the waters of the western lakes began to flow. With the drawing

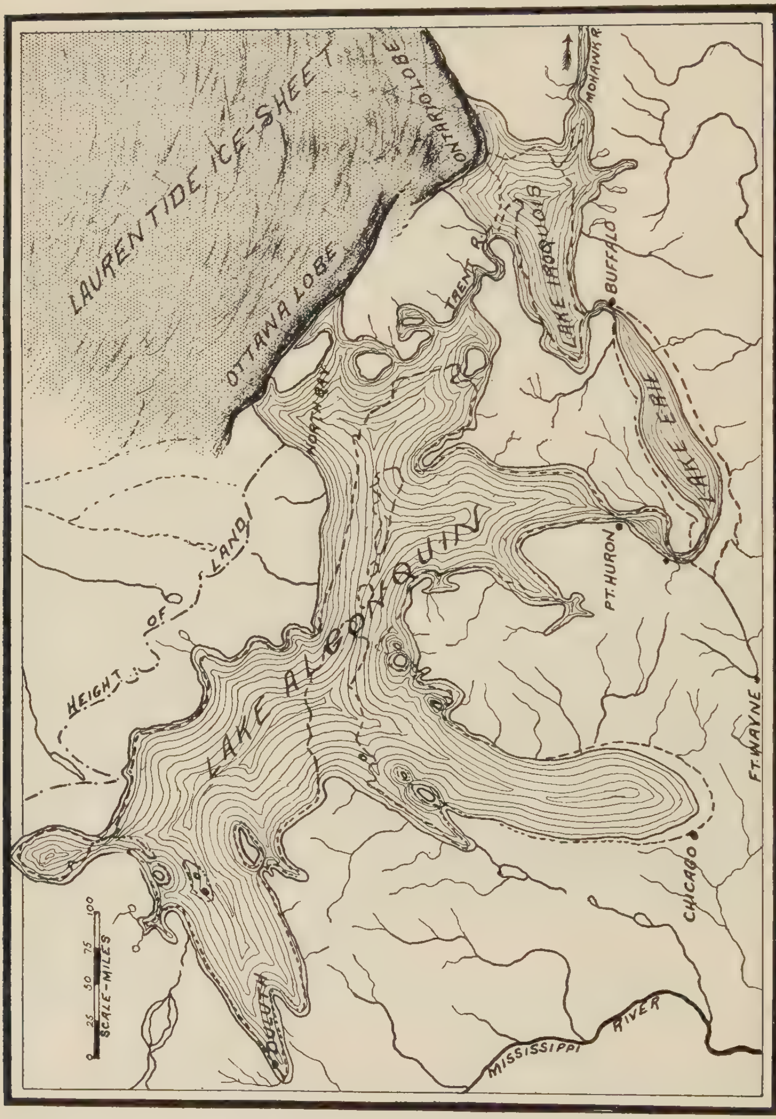


FIG. 4.—LAKE ALGONQUIN, TRENT RIVER, AND LAKE IROQUOIS: OUTLET THROUGH THE MOHAWK VALLEY (REDRAWN FROM A MAP BY F. B. TAYLOR).

off of the waters through the Mohawk valley, the lake in the Ontario basin fell below the level of Lake Erie and Niagara River with its magnificent cataract came into existence. About the same

time, or soon after the fall of Lake Warren, the ice had so far withdrawn from the northern basins as to allow the waters of Lakes Michigan and Huron to unite as one lake with its outlet through the St. Clair river to Lake Erie. This great lake named Lake Algonquin is shown on the map forming Fig. 4. The contemporary lake in the Ontario basin was larger than the present Lake Ontario, and is known as Lake Iroquois.

An interesting stage in the history of the Laurentian basin is illustrated by the map forming Fig. 4, when, owing to movements in the land, Lake Algonquin discharged through the valley now occupied by Trent River. This old channel, in common with others of a similar character, will be referred to later in connection with the influence of the geography of the Lake Region on travel and commerce.

At a still later stage in the changes we are reviewing, the ice withdrew so as to uncover the channel now occupied by the St. Lawrence, and a pre-glacial avenue of drainage of great antiquity became available. The water surface of Lake Iroquois fell, the Mohawk Valley as an avenue of discharge for the drainage of the Great Lakes was abandoned, and the modern St. Lawrence River came into existence. The St. Lawrence follows in general the course occupied by a greater St. Lawrence, which drained certainly a large portion of the Lake Region in pre-glacial time. The northeastern portion of the continent, for a long period during its pre-glacial history, was higher than now by at least 600 or 1,000 feet. The continental border was then about two hundred miles east of Nova Scotia, and the mouth of the Greater St. Lawrence, as has been shown especially by J. W. Spencer, was well to the east of Cape Breton. The Greater St. Lawrence and its principal branches were long lived and deeply entrenched themselves. In post-glacial time a subsidence of the land allowed the sea to encroach on the border of the continent, and the entire extent of the Greater St. Lawrence, the Ontario basin, and a portion of the Ottawa Valley were in direct communication with the sea. At this same stage a narrow strait connected the valleys of Lake Champlain and Hudson River, thus making New England an island. This stage in the history is indicated on the map forming Fig. 5.

All of the valleys, submerged by the subsidence of the land after the retreat of the glaciers, had been excavated in pre-glacial time to a depth greater than they now have. The broader features in what has been termed the hard-rock topography, brought into prominence by this submergence, speak as forcibly as do the broad

basins in the central and western portions of the Lake Region, of the great amount of erosion the land underwent before the coming of the glaciers, and of the immense length of time during which its surface has been above the sea.

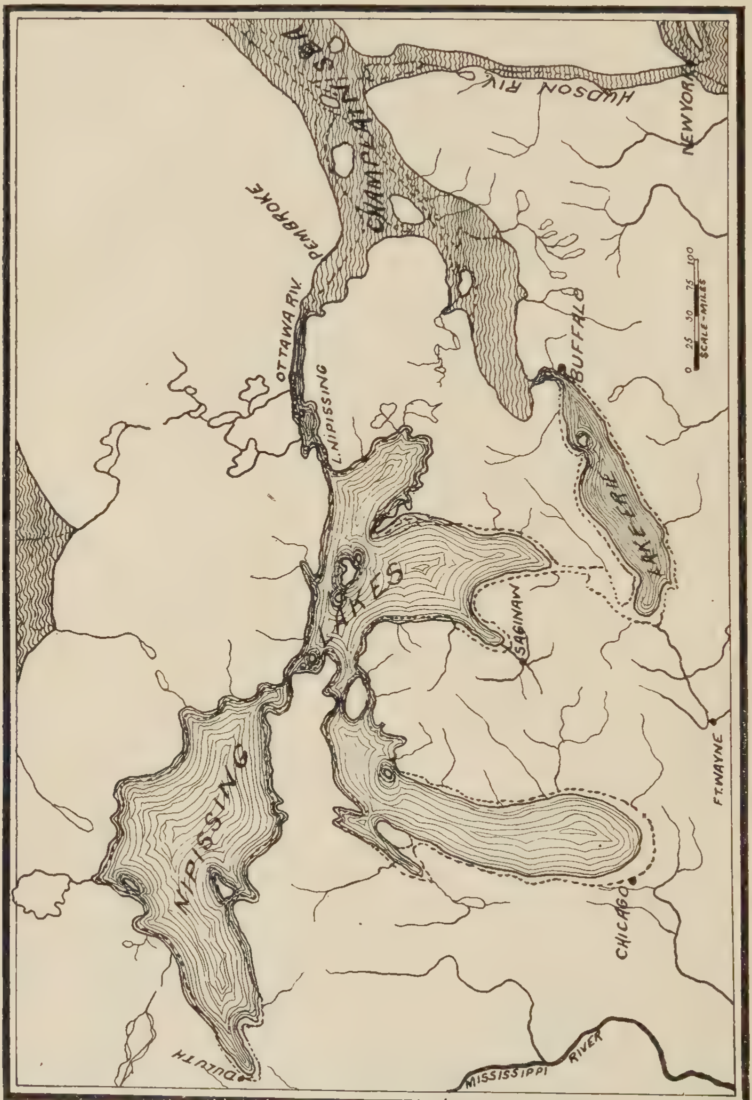


FIG. 5.—THE NIPISSING LAKES, DISCHARGING THROUGH OTTAWA VALLEY TO CHAMPLAIN SEA OR ESTUARY: HUDSON AND CHAMPLAIN VALLEYS SUBMERGED (REDRAWN FROM A MAP BY F. B. TAYLOR).

Subsequent to the stage indicated in Fig. 5 the land again rose, but not to its previous altitude, and the Ontario and Champlain basins were converted into seas occupied by ocean waters. The flooding out

of the salt water has converted these basins into fresh-water lakes. The rise of the land referred to was not sufficient to reclaim the St. Lawrence and Hudson valleys completely, and in the former tide-water now reaches nearly to Montreal and in the latter to Troy.

By referring to Fig. 5, it will be seen that at the stage in this long history there represented, the basins now occupied by Lakes Huron, Michigan and Superior discharged their surplus water through the channel of the Ottawa; movements in the land having diverted the drainage of these basins from the St. Clair River and Lake Erie. During this time, as has been shown by Taylor and others, Niagara Falls lost much of their grandeur.

We speak with confidence concerning the movements in the earth's crust which caused the old lakes to shift their place of discharge, since similar movements are now known to be in progress. The recent change referred to, as has been shown especially by G. K. Gilbert, is of the nature of a downward tilting of the region occupied by the Great Lakes toward the southwest or an upward tilting toward the northeast at a mean rate of .42 of one foot per 100 miles in a century. The bed of the old outlet at Chicago, at the summit of the pass, is but 8 feet above the mean level of Lake Michigan and 5 feet above the highest stage of the lake recorded in recent years. The present rate of land movement continuing, the lake during high water stages will reach the pass in 500 or 600 years, in 1,000 years the discharge will occur at ordinary water stages, and after 1,500 will be continuous. In 2,500 years Niagara will have become an intermittent stream, and in 3,000 years all of its waters will have been diverted to the Chicago outlet.

As may be gathered from this hasty review, the basins of the Great Lakes as they now exist, owe their origin not to a single cause, but to the combined action of at least four agencies. These are: stream erosion which excavated broad depressions; movements in the earth's crust, which tilted the rocks so as to obstruct the free drainage of the valleys; glacial erosion, and what is of more importance, the deposits made by the invading ice sheets. When the glaciers finally withdrew the surface of the region they occupied, more especially in a belt about a hundred miles in general width along its southern margin, was left with a heavy covering of boulder clay, gravel, etc. This covering modified the direction of the streams in many ways, and caused not only the larger valleys to be dammed, but gave origin to thousands of small lakes. The former streams were thrown out of their previously deeply eroded channels in many instances, and had to begin their tasks anew.

These rejuvenated streams have, as yet, made but little advance in the work of cutting down their channels to the level of the still water into which they flow, and are characterized by the presence of innumerable water-falls and rapids.

The land drained by the St. Lawrence is, for this reason, a region of cascades. The grandest of these, Niagara, has cut back a cañon about seven miles long, but all of this task was not performed since the lowering of the surface of Lake Warren. Niagara is too well known, from the writings of Gilbert, Taylor and others, to require special attention at this time. Its magnificence detracts from the attention that would otherwise be given to the many picturesque cascades, especially of New York and Canada, which came into existence at about the same time as its own birth, and have somewhat similar histories.

This abundance of water power, left as one of the many inheritances from the Glacial epoch, has led to the establishment of numerous factories, and the growth of villages and towns; and for this reason the influence of the Glacial epoch on industrial arts is nearly as important as its bearing on agriculture and commerce.

Immediately surrounding the Great Lakes in many places, as, for example, in the Maumee Valley, at the head of Saginaw Bay, over much of Ontario, etc., there are broad tracts of nearly level land left bare by the recession of the former water-bodies. These flat areas are underlain, as previously stated, by a considerable depth of stratified clay, which was deposited as sediment from the ancient lakes.

## INFLUENCE OF GEOGRAPHICAL CONDITIONS ON EXPLORATION AND SETTLEMENT.

The numerous geographical changes briefly sketched in the preceding pages, left the Lake Region with certain pronounced characteristics, which have had a direct and intimate bearing on the lives not only of its aboriginal inhabitants, but of European immigrants as well. The geographical features of most marked importance in this connection are those due to (1) pre-glacial stream-erosion, (2) glacial deposition, (3) post-glacial stream-erosion, and (4) movements in the earth's crust. The first established the general courses of the great rivers, both within the present basin of the St. Lawrence, and on its borders, and produced the broad valleys, since dammed and converted into lakes; the second spread a deep mantle of broken and comminuted rock *débris* over the entire area, partially filling the valleys and obstructing their drainage; the third led to the excavations of many valleys, especially those occupied

by the streams draining ice-dammed lakes; and the fourth produced important changes in the lakes, and caused the sea to invade the low lands in the eastern part of the Lake Region.

The main influence of these many changes on the aborigines was of course in the production of the Great Lakes, on the shore of which many Indian tribes had their homes. The lines of communication furnished by the valley and streams, the fishes of the lakes and rivers, the forests on the land, with their abundant animal life, and to a limited extent, the favorable condition as respects soil and climate for agriculture, all had a direct bearing on the lives and development of the uncivilized tribes, but may be better illustrated by the rapid advance and marvellous growth of European colonies.

Of the main geographical features referred to above, the last, namely, the drowning of the St. Lawrence valley by an advance of the sea far inland, was the first to exert its influence on the history of civilization.

In 1534, Cartier entered the broad estuary of the St. Lawrence and ascended it with his ships as far as the site of Quebec. Continuing his explorations in open boats, he succeeded in reaching the bold mountain at the base of which Montreal now stands. The hope of discovering the much-sought-for northwest passage was blighted when tide-water was passed, and the great river of which the estuary is a continuation was entered.

A minor influence of topography on both native peoples and on French exploration and settlement, is illustrated by the fact that Cartier found an Indian village at the mouth of the Saguenay, another at the site of Quebec, and a third where Montreal has since been built. Each of these localities also marks a stage in the travels of the first band of Europeans to see the beautiful shores of the St. Lawrence. The Indian village known to the French as Tadousac, at the mouth of the Saguenay, and Hochelaga, at the junction of the Ottawa with its master stream, were in the days of Indian warfare, as at the present time, strategic localities, which commanded lines of travel branching from the St. Lawrence highway. What was probably equally determinative in the selection of those village sites as well as the one where Quebec now stands, was the occurrence of conspicuous land marks at each locality. Although the promontories referred to do not appear themselves to have been occupied by Indian villages, they no doubt afforded look-out stations, and were besides mile-stones in river navigation and definite localities in the wilderness, easy of description and location, and suitable for meeting places. In traversing a region of generally

mild relief, as all travellers in a wild country are aware, an isolated promontory attracts one toward it, even if he has no definite aim in view. Even without special arrangement prominent land-marks determine halting places. For these several reasons Indians travelling in their canoes centuries ago determined the sites of the great cities of Canada.

Following Cartier came Champlain, who greatly extended the claims of France in the New World. In 1609, he discovered the splendid lake now bearing his name, reaching it by way of the ancient valley through which its waters flow to the St. Lawrence. This line of communication leading from the St. Lawrence to the Hudson, which was excavated by a river in pre-glacial time, and occupied by the sea after the last retreat of the glaciers, was first traversed from tide-water in the St. Lawrence estuary to tide-water in the Hudson estuary by Father Jogues, one of the most intrepid of Jesuit missionaries. Later, it became a well-trodden route for French and English both in times of peace and war. Its importance in war is recorded by Ticonderoga, Bemis Heights and Saratoga. Commerce and travel have followed the paths marked out by natural conditions for Indian war parties and French and English armies. Railroads and canals now connect the St. Lawrence and Hudson estuaries by way of this historic pass.

In 1613, the first white man, Father Joseph Le Caron, ascended the Ottawa, and was followed the same year by Champlain, who made a second journey by the same route a year later, and discovered Lake Huron. This line of travel, from Montreal up the Ottawa to Lake Nipissing and thence down French River to the "Mer Douce," it will be remembered, ascends the course of one of the outlet streams of Lake Algonquin. This route, although beset with many difficulties, it is safe to say would not have been available even for canoe navigation but for the work done by the river that formerly flowed along it and prepared a way by which the Indians of the Northwest could avoid their enemies, the Iroquois, who occupied central New York and made travelling dangerous on Lakes Ontario and Erie. This same Ottawa route, cutting across the great detour made by the waters of the Upper Great Lakes at the present day in order to make their plunge over the Niagara escarpment, was chosen in recent years for the trans-continental railroad of Canada. The valley of the Trent, once the outlet of Lake Algonquin, was traversed by Champlain and his Indian allies, while on his way to attack the stronghold of the Iroquois in northern New York. In 1641, Father Jogues, undaunted by his previous

experience among the Mohawk Indians, reached Sault Ste. Marie. The importance of the line of travel then discovered, and the great influence it has had on the commerce and development of the entire Northwest, will be more fully considered in advance.

Fathers Marquette and Joliet, in returning eastward after their arduous journey which made known the upper Mississippi, ascended what are now known as Illinois and Des Plaines Rivers, and reached the south end of Lake Michigan by way of the old river channel, carved by the waters flowing south from the Michigan basin. The divide left when the waters of Lake Warren were diverted from the outlet at the present site of Chicago to the Mohawk, as we have seen, is low, only eight feet at the summit above the normal stage of Lake Michigan. Accounts that have come down to us show that during the early settlement of northern Illinois this old outlet was so nearly restored during unusually high stages of the streams, that canoes and even rafts of logs could be taken through it. This channel, initialed by the stream flowing from Lake Chicago, was a much frequented portage in the days of canoes long before the coming of the French, and since that time has never ceased to increase in importance as a commercial thoroughfare. It is now being deepened and made suitable as a drainage canal for Chicago, and will no doubt in the near future become an important link in the waterway between the Mississippi and the St. Lawrence. As we have already noted, geologists have foretold the date at which this long-abandoned river bed will again be occupied if the slow changes in progress are not modified.

The river supplied by Lake Maumee carved a broad channel leading west from the present site of Fort Wayne, and as in the case of the similar stream flowing from Lake Chicago, furnished a favorite route for Indian travel. This was the easiest and best route for canoe navigation between Lake Erie and the region drained by the Mississippi. This same portage was used by the French and English during colonial days, and later, was included in one of the first railroad-routes to the West, and is still one of the great railroad thoroughfares of America. In northern Ohio and central New York there were several small lakes during the earlier stages of the final retreat of the ice of the Glacial epoch, of the same general character as Lake Maumee. Although no mention of these lakes was made in the brief sketch of the geographical history of the Lake Region previously given in this essay, yet, as is well known, their outflowing waters cut deep trenches across the divide now parting the waters flowing northward from those finding their way

southward to the Ohio, Susquehanna, etc. These passes are known to have been used by Indians, and especially by the Iroquois, in making raids into the lands of their enemies at the south. In these modern days of railroads, these same routes are in several instances traversed by shining bands of steel which unite the commerce of the North and South.

The most important of the outlet channels of the old lakes previous to the re-occupation of the St. Lawrence valley, was by way of the Mohawk and the Hudson. The valleys of these rivers are of ancient date, and have furnished the lines of stream transportation down which vast quantities of sediment have been carried from the land to form new deposits in the sea. The glaciers modified these old river-valleys to some extent by abrading their walls and bottoms, but the greatest changes produced by the ice occupation are due to the deposition of clay, boulders and other glacial refuse. Later, the rivers flowing from Lake Warren and from Lake Iroquois removed some of the material left by the glaciers, especially in the valley of the Mohawk, and made it more serviceable as a line of communication between the East and the West.

The Mohawk valley furnishes the only broad, low pass across the mountain belt adjacent to the Atlantic, south of the St. Lawrence, until, in Georgia, the southern end of the Appalachians is reached. This natural thoroughfare played an important part in the relations of Indian tribes, and, as history shows, exerted what may be termed a negative influence on the spread and interrelations of French and English colonies. The Mohawk valley and the plateau of central New York failed to influence the growth of the European colonies in the manner that might be expected from purely geographical considerations, for the reason that they were occupied by the most intractable and warlike tribes of Indians on the American continent. The Iroquois filled this gap in the mountains, and during the most critical period of colonial history separated the French from the English as effectually as did the rugged mountains to the southeast and northwest of their densely-forested hunting-grounds.

When once the power of the Iroquois was broken, the valley of the Mohawk invited the English colonists, and a tide of immigration which has not yet ceased, began to flow through it. The work of the river that drained Lakes Warren and Iroquois lightened the task of the engineers who planned the routes of the Erie Canal and the New York Central Railroad. Far-reaching plans for a deep waterway connecting the Great Lakes with the Atlantic, through

this thoroughfare and uniting the North with the South and the East with the West, are now being matured.

Even this brief outline of the intimate connection between geographical and human history, as illustrated by the region under review, is sufficient, I think, to show that in many ways the destinies of nations and the march of civilization have been directed and modified by seemingly unimportant geographical changes, initiated thousands of years before white men came upon the stage of action. But for the deep trench cut by the Greater St. Lawrence, French explorers would not have been able to make known the region of the Great Lakes before colonies were established on the New England coast. We cannot say that America would not have been fought over by Spain, France and England had there been no passes through the mountains bordering the Atlantic and no Glacial epoch, but the course of events under such conditions would certainly have been far different from what we now find recorded in history. The influence of the Appalachian Mountains in restricting the spread of the English colonies westward, and of the St. Lawrence estuary and the Great Lakes in inviting the French to extend their settlements indefinitely, is indicated by the dates of a few pregnant events in American history. For example, Cartier reached the site of Montreal, a thousand miles from the sea, in 1534, before more than a beginning had been made by the English in tracing the outline of the Atlantic coast, and seventy-three years before the planting of a colony at Jamestown; Detroit was founded in 1701, or fifteen years previous to the crossing of the Appalachians by Governor Spotswood. This much-lauded but tardy excursion of the Governor of Virginia occurred thirty-four years after La Salle had navigated the Mississippi from Illinois to the Gulf of Mexico. Many other intimate connections between the geographical history of America and the welfare of our ancestors and ourselves might be enumerated. These connections are not only broad and far-reaching, but in numerous instances have a direct and tangible bearing on minor events. Manufacturing towns have sprung up where pre-glacial streams were turned from their courses so as to furnish water-power; the drowning of river valleys has led to the growth of great cities at the heads of estuaries; ancient river valleys have furnished passes for canals and railroads; former lake-beds afford broad, level farm-lands; the terraces of deeply gravel-filled valleys have been chosen as sites for villages and cities; ancient valleys, dammed by glacial deposits, have been converted into lakes with a wealth of fish life, which afford

unrivaled ways for commerce—these and a thousand other connections between the present and the past, many of them still unrecognized by historians and statesmen, have guided the affairs of nations and to-day influence the routine of our lives.

## MINERAL RESOURCES.

The various stores of what are termed mineral wealth in the Lake Region had but little importance to the Indians. Native copper was mined in a rude manner from natural outcrops; flint was obtained from loose boulders for arrow points and spear heads; ochres were used for paint; mica for personal decoration; clay was manufactured into rude pottery; and certain soft rocks were utilized for pipes. This brief catalogue could perhaps be slightly extended, but an exhaustive study would fail to show that the Aborigines had more than a slight knowledge of the marvellous mineral resources of their broad domain. With the advance of civilization greater and greater demands have been made on the stores of material and energy accumulated in the earth's crust.

In the Lake Region, the rocks, especially limestone, sandstone, granite and basalt, furnish an inexhaustible supply of building stone and road metal. Clays are abundant for the manufacture of all the coarser kinds of pottery and for tiles, bricks, etc. Kaolin is known to exist, but has not been utilized. Extensive deposits of marl and clay are available for cement. Limestone and gypsum are largely employed in New York, Ohio and Michigan for lime and plaster. Hydraulic limestone is quarried on an extensive scale at Buffalo. Salt occurs in vast quantities in New York, Ontario and Michigan, and is the basis of a great industry; in 1894 the output was in the neighborhood of twelve million barrels. Chemical works near Detroit, with millions of dollars invested, are producing sodium carbonate. Phosphates for fertilizers are mined in the crystalline rocks of Canada, and the same terranes yield gold in considerable quantities, although small in amount in comparison with many other regions in America. Coal seams occur in the southern peninsula of Michigan, but although giving promise of important development in the near future, now yield less than 100,000 tons a year. Gas and oil fields in Ontario and northwestern Ohio are well within the Laurentian basin. None of the industries based on the geological resources just mentioned, however, have reached the development of which they are capable. There sources of wealth may be said to be held in reserve for future generations.

The great industries which draw their raw materials from the geological resources of the Lake Region centre about its vast iron and copper deposits.

The principal iron mines, not considering for the present the red ores of the Clinton rocks from New York westward to Wisconsin, or the much more important magnetite deposits of the crystalline rocks of New York, are the vast beds of hematite and magnetite on the south shore of Lake Superior, and similar but as yet undeveloped ores in adjacent portions of Canada.

The deposits of native copper on the south shore of Lake Superior have made Michigan not only the leading copper-producing centre in the United States, but given her a controlling voice in the copper markets of the world. With the copper occur minor quantities of native silver.

The production of both iron and copper has been increasing ever since their development began, and there is no evidence that the maximum has been reached. The supply seems to be regulated solely by the demand. The above statements may perhaps seem too sanguine, but I believe are fully sustained by statistics which show that the copper mines of Michigan produced 101,410,277 pounds of copper in 1890. The iron ores shipped from Michigan and Minnesota in 1895 amounted to 89,678,897 tons, or considerably more than one-half of the total production of the United States for the same year.

## AGRICULTURAL RESOURCES.

The agricultural resources of the Lake Region are too well known to require extended description at this time. The fairest portions of New York and Ontario, the former the most productive of the northeastern States, and the latter the richest province of Canada, lie within the area draining to Lakes Ontario and Erie. Northern Ohio, small portions of Indiana and Illinois, nearly the whole southern peninsula of Michigan, and the eastern portion of Wisconsin need but to be named to show the great agricultural interests to which space denies consideration.

The basis of this vast agricultural development, the greatest source of wealth and strength of the Lake Region, lies, first, in the rich and varied soil left by the glacial invasion, and, second, in the climate which is tempered to a marked degree by the equalizing influences of the Great Lakes.

Owing largely to the warming of the air in winter by the slow escape of heat from the Great Lakes, and the cooling effect of the

same water bodies in summer, by evaporation which supplies moisture to the air when most needed, the agricultural region just referred to is also a highly productive fruit-growing area. The apples, peaches, pears, grapes, etc., and berries of various kinds, grown on the shores of the Great Lakes, are unsurpassed in perfection of form and richness of flavor by any other portion of America.

## FORESTS.

In its natural state practically the whole of the land draining to the St. Lawrence was forest covered. With the development of agriculture and the growth of towns and cities much of the native forest has been entirely removed, and the inroads of timber cutters have greatly modified those portions which have escaped complete destruction.

A remarkable feature of the primitive forest was the intimate commingling of hardwood trees, such as the oak, hickory, black walnut, elm, beech, maple, etc., with coniferous trees, of which several varieties of pine, spruce, cedar and tamarack were in greatest abundance. This meeting of the floras of northern and southern lands, owing to favorable soil and climatic conditions, rendered the dense forests of the Lake Region unrivalled both in beauty and in usefulness by those of any other portion of the continent.

The special characteristic of the primitive forests, so far as the interests of lumbermen were concerned, was the vast number and large size of the white pines. The forests of Michigan, especially, have become renowned for the great quantities of white-pine lumber afforded by them. The demand for this valuable wood was so great, and was met in such a ruthless manner, that the supply is nearly exhausted. In some of the counties of Michigan, which were once centres of the lumber trade, a white-pine tree of even average size is now a rarity. Since the decline of the pine as a basis of industry, other lumber-producing trees have come into demand. Hard wood, more especially oak, maple and hickory, is still obtainable and largely used, and softer wood, like that of the cottonwood and spruce, is now being extensively utilized for wood-pulp and other purposes.

In spite of the wholesale wastefulness that has characterized the lumber industry of the Lake Region, there is still hope that scientific forestry will be able to repair some of the damage that has been done, and so rejuvenate the forests that they will meet all

legitimate demands that may be made on them by future generations.

## FISHERIES.

The waters of the Laurentian basin, as well as its land areas, yield a harvest for the sustenance of man. The streams and smaller lakes abound in fishes of several species such as the bass, perch, pickerel, brook trout, etc., valuable, not alone for food, but in furnishing sport and recreation for lovers of the rod. The great commercial supply of fishes, however, comes from the larger lakes.

Of the lake fishes the most abundant and the ones of greatest value are the trout, white fish, lake herring, pickerel, sturgeon and perch. The importance of these fresh-water fisheries as a source of food supply is indicated to some extent by the following statistics, obtained from the U. S. Fish Commission.

FISHERIES OF THE GREAT LAKES, 1895.

| | |
|---|---|
| Men employed . . . | 21,194. |
| Fish taken . . . . | 99,842,076 pounds. |
| Value of the fish taken . . | $2,691,866. |
| Caviar . . . . . | 477,020 pounds. |
| Isinglass . . . . | 7,257 " |
| Oil . . . . . . . | 17,435 gallons. |

To this must be added the similar industry in Canadian waters, which makes the total annual product of the Great Lake fisheries over $4,500,000 in value.

The activity with which the fishing industry in the Great Lakes has been carried on during recent years, and the lack of forethought has led to somewhat critical conditions in reference to the permanence of the supply. Wasteful methods similar to those which characterize the lumber industry already referred to, have prevailed in the lakes as well as on the land. But in much the same way that scientific forestry gives promise of a reform, which will lead to the preservation of the wood-lands still remaining, and insure their becoming of continuous value, so scientific methods applied to the preservation and continuance of the fisheries will guarantee their permanence for generations to come.

## COMMERCE.

The commerce of the Great Lakes perhaps illustrates better than any other industry not only the remarkable prosperity of the regions bordering on these fresh-water seas, but its rate of increase

furnishes a sure promise of a still more marvellous growth in the near future.

The first sailing vessel to be built on these inland waters was *Le Griffon*, constructed under La Salle's direction in 1679. Practically, however, the commerce of the Great Lakes did not begin until more than a century later, and received its greatest impetus in 1835, when steam was introduced.

Statistics are here more eloquent than words. The following table, showing the commerce which passed north and south through Detroit River in 1889, tells its own story:

COMMERCE OF THE DETROIT RIVER, 1889.

Vessels passing, 32,415. Tonnage, 19,646,000.

Three times the foreign trade of New York.

10,000,000 tons in excess of foreign trade of all United States ports.

3,000,000 tons in excess of foreign and coast trade of London and Liverpool.

COMMERCE OF DETROIT RIVER, 1894.

Vessels passing, 34,800. Tonnage, 26,120,000.

The present importance and the promise of future growth of the commerce of the Great Lakes may be illustrated from another point of view. The shipping of the world is estimated at 18,240,000 tons; of this 4,769,020 tons belong to the United States, and of these 1,483,068 tons are to be credited to the Great Lakes. In 1897, vessels aggregating 116,937 tons were launched at the ship yards of Cleveland, Detroit, Chicago, and other lake ports; while the increase to the shipping at both the Atlantic and Pacific ports of the United States, amounted to 115,296 tons. The total American steam tonnage has increased 816,000 tons during the last ten years; 590,000 tons of that increase belong to the lakes. To-day there are on the lakes 2,120 steam and 1,324 sailing vessels, under the American flags, and 748 steam and 556 sailing vessels belonging to Canada. In addition there are about 3,000 fishing-smacks, yachts and other small craft. Additional data in this same connection may be found in a highly instructive article by F. W. Fitzpatrick in *The Cosmopolitan* for May, 1898.

The reports of the Deep Waterway Association and of the Deep Waterways Commission furnish a means for constructing a curve to show graphically the rate of increase in the number of vessels engaged in the lake trade during the present decade, their tonnage, character and value of their freight, etc. Such a curve would show

a rapidly increasing rise throughout, with a marked upward tendency especially during the past ten years. In connection with this promise of still greater developments to come, there is the confident expectation that the Great Lakes will soon be connected with the Atlantic by deep waterways suitable for ocean-going steamers, and also with the steamboat navigation of the Mississippi.

## DEEP WATERWAYS.

The national importance of the commerce of the Great Lakes has led to the consideration of wide-reaching plans for a deep waterway connection between these fresh-water seas and the Atlantic.

Such an outlet for the commerce of the Great Lakes is desirable, not only to secure cheaper rates for the transportation of grain produced in its southwestern part of the Laurentian basin and the far vaster wheat lands of the Upper Mississippi Valley and adjacent portions of Canada, and to afford a wider market for the ores and forest products of the Lake Superior region, but also for the greater development of the already extensive shipbuilding industries of the lake cities.

A beginning in the way of connecting the fresh with the salt seas has already been begun by the building of the Erie Canal, and by a series of still deeper canals constructed by the Canadian Government. Lakes Erie and Ontario, as is well known, are now united by Welland Canal, which is one link in a system embracing several canals between Lake Ontario and Montreal, by which vessels drawing about nine feet of water may pass to and fro between the St. Lawrence estuary and the Great Lakes. In these improvements the Canadian Government has already expended over sixty million dollars. Since the construction of the Welland Canal the tonnage of the lake shipping has so vastly increased that at the present time what may be considered as the normal sized vessels used on the Great Lakes, for either freight or passenger carriage, are denied not only an outlet to the ocean, but cannot pass between Lakes Erie and Ontario.

In order to facilitate lake commerce, and with a view also to an ultimate communication with the ocean, far-reaching plans of harbor and river improvements have been under way for many years by the United States Government. The rivers connecting Lakes Superior and Huron and Lakes Huron and Erie, have been deepened in places and canals excavated, so that at the present day vessels drawing 21 feet of water can pass from any one of the

upper Great Lakes to any other, but as yet Lake Ontario is shut out of this system.

The most important of the improvements just referred to are at the outlet of Lake Superior. St. Mary's River there makes a steep descent of 21 feet, forming the rapids known as Sault Ste. Marie. These falls were a serious hindrance even to canoe navigation, and necessitated a portage of about one mile. To obviate this difficulty a canal, 2,580 feet long and provided with a lock 8 feet 9 inches wide, was constructed on the Canadian side of the river in 1777–78, but so far as can be learned was in operation but a short time. Remains of this, the first canal in the Lake Region, are still to be seen. The next step in the improvement of navigation between Lakes Superior and Huron was the construction of a tramway on the American side, previous to 1850, for the transfer of goods and also for the portage of small boats. Oxen were used to move boats over the tramway, which was the first "ship railway," if it can be dignified by the name, in America.

In 1853, a ship canal was begun by the State of Michigan, and completed in 1855. This canal was 5,400 feet long, 100 feet wide and 12 feet deep, and was provided with two locks each 350 feet long, 70 feet wide and with 11½ feet of water on the sills. The ownership of this canal with its locks, etc., was transferred to the United States Government in 1881. Improvements were then made and a new lock finished. This lock, still in operation, is 515 feet long between the gates, 80 feet wide, narrowing to 60 feet at the gates, and has 17 feet of water on the sills under normal conditions. At times, however, vessels drawing over 14½ feet of water cannot pass. This lock was completed in 1881, and cost $2,150,000.

The growth of commerce soon demanded a deeper canal at the Sault, and in 1896 a third lock was completed, now known as the "Poe Lock," in honor of the distinguished engineer who had charge of the work. This new lock, built on the site of the old State-Lock, is 800 feet long, 100 feet wide, and has a depth of 21 feet of water on the sills of the gates. It cost over $5,000,000.

Rivalry between American and Canadian interest made it desirable to have a canal on the Canadian side of the Sault, and in 1895 the Canadian Government finished the construction of a canal with a lock similar to the Poe Lock, at a cost of about $4,000,000.

The importance of the commerce passing the St. Mary's Falls canal previous to the opening of the Poe and Canadian locks, is

shown below, together with certain comparisons with the commerce of the Suez Canal.

St. Mary's Falls Canal and Suez Canal, 1894.

| | | |
|---|---|---|
| St. Mary's, open | 234 days | |
| Suez, open | 365 days | |
| St. Mary's; No. of Vessels passing | 14,491 | |
| Tonnage | | 13,110,366 |
| Suez; No. of Vessels passing | 3,352 | |
| Tonnage | | 8,039,105 |
| St. Mary's in excess of Suez | 11,139 vessels | |
| St. Mary's in excess of Suez | 5,071,261 tonnage | |
| St. Mary's, 1897; Vessels passing | 18,615 | |
| Tonnage | | 16,299,061 |

Some idea of the character and value of the freight passing the "Soo" may be obtained from the following statistics:

St. Mary's Falls Canal, 1895.

| | |
|---|---|
| Number of Vessels passing | 17,956 |
| Registered Tonnage | 16,806,781 tons |
| Freight | 15,062,580 tons |

Value of Freight.

| | |
|---|---|
| Coal | $6,993,351 |
| Flour | 33,386,632 |
| Wheat | 30,041,863 |
| Grain, other than Wheat | 4,164,374 |
| Manufactured Iron | 3,863,150 |
| Pig Iron | 346,788 |
| Salt | 202,439 |
| Copper | 21,490,400 |
| Lumber | 8,888,400 |
| Silver Ore and Bullion | 11,200 |
| Building Stone | 238,760 |
| Unclassified Freight | 27,798,480 |
| Total | $159,575,119 |

The comparisons just made between the commerce of the "Soo" and of the Suez canal, however, are misleading in certain respects. For example, the voyages of the vessels passing between the Mediterranean and the Red Sea are much longer than those of the vessels plying to and from Lake Superior. The important difference

between "long and short hauls" here comes in. Again, the vessels engaged in the traffic of the Suez Canal are much larger on the average than those of the lakes, and their freight is of a higher grade, and of much greater value per ton. When one has all of these qualifying facts in mind, however, the vast importance of the commerce of the Great Lakes does not suffer from being contrasted with that of the greatest of deepwater ways now in operation.

The construction of deeper and deeper waterways between Lakes Superior and Huron has been followed in each instance by an increase in commerce and an enlargement of the vessels engaged in both passenger and freight transportation. The larger vessels now sailing the Great Lakes compare favorably with the best of ocean going vessels engaged in similar lines of traffic. The magnificent steamers the *Northwest* and *Northland*, plying between Buffalo and Duluth, a distance of nearly 1,000 miles, are each 388 ft. long, 44 ft. beam, and provided with twin screws and quadruple expansion engine of 7,000 indicated horse power. These steamers are handsomely appointed and in every way compare favorably with the average Atlantic liner. A voyage on one of them has all the fascination of an ocean journey with the inconvenience arising from heavy seas largely eliminated.

The largest freight steamer thus far built on the Great Lakes is the *William R. Lynn*, 420 ft. over all, 48 ft. beam, with a freight capacity of 6,800 tons.

An increase in depth of water in the locks at Sault Ste. Marie, would, in the opinion of competent judges, be immediately followed by still greater increase in the size of ships engaged in the freight traffic.

The canals and locks at the "Soo" are considered by far-sighted engineers and statesmen to be but a link in a chain which will ultimately furnish a deep-waterway connection between Lake Superior and the Atlantic. The desire to have such a connection made has become popular and is now claiming the attention of both the Canadian and United States governments. An International Deep Waterways Association, holding its first convention at Cleveland in 1895, was followed by the appointment of a Deep Waterway Commission by President Cleveland in 1897, consisting of James B. Angell, John E. Russell and Lyman E. Cooley, for the purpose of considering the project of a ship canal from the Great Lakes to the Atlantic, in all of its aspects. This Commission has made a preliminary study of the several routes available, and of some of the less extensive improvements necessary to bring all of the Great

Lakes into connection with ocean commerce. In the highly important report of the Commission a large amount of data bearing on the project under consideration has been issued.* A general map accompanying the report is reproduced on a reduced scale in Fig. 6. Without attempting to give even an abstract of the considerations bearing on the several routes that have been proposed, I may state that what is considered by several competent judges to be at the same time the most economical and most beneficial plan, contemplates the deepening of the existing waterway between Lakes Superior and Huron, and between Lake Huron and Lake Erie, so that a vessel drawing 31 feet of water may pass through them. Under this plan Lakes Erie and Ontario would have to be connected by a canal passing around Niagara Falls and Lake Erie connected with the Hudson River near Troy by a canal starting at Ogdensburg, New York, and leading to Lake Oneida, then through the Mohawk valley to the Hudson. Many considerations also favor an outlet by way of the St. Lawrence and a communication between the St. Lawrence and the Hudson by way of Lake Champlain.

These several routes are indicated on the accompanying map, but space forbids an attempt to discuss their comparative merits at this time. It would be well, however, if the great project of grafting the commerce of the Laurentian Lakes on to that of the ocean could be widely discussed, as it is one to which statesmen as well as engineers and financiers will have to give careful consideration in the near future. The rate at which the Lake Region, and the country adjacent, especially on the south and west, is advancing in all that pertains to civilization, is abundant evidence of the desirability of increasing the facilities for transportation, and thus lessening the time and cost of placing the products of the "Old Northwest" in the markets of the world.

It is of interest to note that each of the routes to the sea discussed by the Deep Waterways Commission has a direct connection with the geographical history outlined on the earlier pages of this essay. Each route follows a line of ancient drainage, and has been influenced by changes in level. The Mohawk route owes its existence to the work of ancient streams, but suffered many changes, some favoring and others opposing the work of canal construction, during and since the Glacial epoch. The excavation performed by the river draining Lake Algonquin and more recent water bodies of the same general character did much to prepare the way for a

* Report of the United States Deep Waterway Commission, Washington, 1897, 54th Congress, 2d Session. House of Representatives, Document No. 192.

ship-canal, by which the waters of the Ontario basin and the Hudson may again be united. The St. Lawrence and Champlain route has been modified, especially by the deposition of heavy beds of clay, sand and gravel, during the time when the Hudson-Champlain valley was an arm of the sea. These deposits have partially filled the old channels, and, on the whole, lead to conditions which make the excavation of a ship-canal more difficult than it would have been had a drowning of the old valleys not occurred.

The fact that the geographical development of the Lake Region has, on the whole, been highly favorable for human progress, is shown not only by the advantages that have been taken of the natural resources and the growth of commerce, but in many other ways. Schools, colleges and universities have been established, which are doing a splendid work in the way of disseminating knowledge and stimulating intellectual activity.

The marvellous advance of the Lake Region in population, wealth and intelligence is indicated—at least to all persons who have some knowledge of the region—by the statement based on the latest census, that it has upwards of eight millions of inhabitants, and includes such flourishing cities as Rochester, Syracuse, Toronto, Buffalo, Cleveland, Toledo, Detroit, Milwaukee, Chicago, Marquette and Duluth.

With the harmony and community of interests that exists between Canada and the United States, it is safe to predict that more marvellous development of the Lake Region, which, instead of dividing, unites these two countries of the same blood, will be witnessed during the twentieth century than has been attained since the days of Cartier, Champlain, Jogues, La Salle, Marquette, Joliet, and many other explorers, missionaries and traders, who gave their energies, and in many instances their lives, to the task of extending the influence of France and the Church. Instead of winning a race of barbarians to the Cross, as was the chief aim of the French, a way was prepared for a higher and better civilization than the world has yet known.

# WASHINGTON LETTER.

WASHINGTON, D. C., JUNE 10, 1898.

ALASKA SURVEYS.—The Geological Survey party, under Mr. George H. Eldridge, reached the head of Cook Inlet on April 27. They found at that time the ice in Sushitna River about to break, so that they hoped to be able to ascend the river by the middle of May. It was planned to detach a party under the direction of Mr. Spurr when they should reach a tributary reported as coming in from the west about 30 miles from the mouth. This small party is to cross the divide to the Kuskokwim, descending this river and possibly making the lower portage to Yukon River and rejoining the main camp at St. Michaels in September, or, possibly, should circumstances permit, turn toward the south to Bristol Bay, and from there reach St. Paul on Kadiak Island.

The principal party under Mr. Eldridge was, at the time he wrote, to go up the river to the main forks. He learned that the fork on the right had been ascended by a party of prospectors. Ascertaining from these men something of the country, he intended to take the more northerly or left-hand fork leading to a less known region and one concerning which information might be of greater value. Indians were found who had traversed these rivers in the winter, but who could give little information concerning the difficulties of summer travel.

One of the latest additions to the literature of Alaskan geography is contained in the bulletin of the Department of Labor for May, 1898. This has been prepared for the purposes of giving information relating to the opportunities for employment in the gold region. It consists largely of a narrative by Mr. Sam. C. Dunham of a trip undertaken by himself, under instructions from the Commissioner of Labor, beginning at Dyea on August 23, 1897. Besides the personal narrative, given in an interesting manner, are many general statements of the geography and condition of development of the country. With these are abstracts of statements from various individuals or officials met on the way, and sketch maps and views of important points.

The expedition of the Coast and Geodetic Survey to explore the mouths of the Yukon River has been delayed by difficulties of transportation and by not having at hand the light-draught boats,

which were built for the purpose of penetrating the waterways of the Yukon delta. These boats have been constructed in sections, and are being shipped to San Francisco, from which point they will be transported to the Yukon by the first available means. It had been planned to utilize the gunboat *Wheeling*, but on account of the war some other vessel must be taken.

No official chart has been made of the waterways leading from the ocean up to the main stream of the Yukon, and it is believed that a better channel than the one now used may be found. It is proposed to first go up this known channel and then attempt to work out in various directions to the outer bar, taking many soundings and carefully mapping the entire area.

FORESTRY IN THE DEPARTMENT OF AGRICULTURE.—On July 1 a change is to be made in the personnel of the Forestry Division of the Department of Agriculture, and probably also in the character of the work performed. Mr. Gifford Pinchot, who has been selected as chief of this important branch of investigation, possesses unusual qualifications for successfully conducting this work, combining the energy and adaptability of a native-born American with a thorough training and practical experience in forestry work. He was born in Connecticut in 1865. His ancestors on one side came over with the Plymouth Colony, and on both sides were engaged in the Colonial and Revolutionary wars. He prepared for college at Exeter and in New York, and graduated at Yale with the class of 1889, taking the DeForest medal, and later going abroad, where he took a course in the French forest school; later he travelled extensively in the German forests with Sir Dietrich Brandis, First Inspector-General of Forests to the Government of India. Mr. Pinchot's forest studies were directed by the latter. After seeing much of the methods of forest management in France and Switzerland and something of the same in Austria, he returned to America and began to visit and report upon various properties, giving especial attention to forest conditions in Arkansas, Georgia, North Carolina, Arizona, California, Oregon and Washington, and later in Pennsylvania and New York. In 1892 Mr. Pinchot took up what is considered to be the first instance of forest management in the United States; this was at Biltmore, North Carolina. He prepared the exhibits for the World's Fair at Chicago to represent the work in the Biltmore forest and the forest condition of the State of North Carolina. Later he became a member of the National Forest Commission, visiting the forests in Montana, Idaho, Oregon, California, Arizona and Colorado, making long trips with

pack trains or on foot. Upon the completion of this reconnaissance he was designated as the representative of the Secretary of the Interior, and in this capacity visited many of the national forest reserves, particularly the Flathead, Lewis and Clarke, Priest River, Washington, Olympic, and Black Hills. He thus enters upon his new duties with an understanding not only of methods abroad, but also of the conditions at home. With this wide view, it is to be assumed that he will be able to devise and suggest methods of forest management suited to present conditions of development rather than attempt merely to imitate what has been done in Europe.

It is anticipated that the results of the work of this division will be of wide geographic interest, as Mr. Pinchot's ambitions are to carry on the investigations in the forests rather than in the office, to know and make known the exact conditions of our woodlands, rather than to speculate about them; and finally he hopes to place before the people of the United States and the farmers practical suggestions which will lead to a larger and better utilization of the forest resources. N.

## RECORD OF GEOGRAPHICAL PROGRESS.

### AMERICA.

War Maps.—It cannot be said that, up to June 1, any of the war maps, with one exception, issued by the private map publishers in the United States, is of special value in following the events of the war. It is announced that about 500,000 copies of the most pretentious of these publications, a folio of sixteen pages, have been issued. It proves to be nothing but a hurried throwing together of old and highly colored plates. None of the points of prominence in the war is specially distinguishable. Not a coaling station of any nation is indicated, nor any of the cable lines which have been playing a prominent and, as at Cienfuegos, a tragical part in the war. The registering of colors is wretched and the results are most confusing. On the map of North America, for instance, our east coast towns appear to be fifty miles out in the Atlantic, and Havana and Matanzas are apparently on the south side of Cuba. Misinformation bristles on every page. If an attack on Cadiz, for example, should call special attention to that Spanish city, we should learn from the map of Spain in this production that Cadiz, which really stands on the point of a peninsula surrounded by water on three sides, is situated at the bottom of a land-locked bay. Such productions are beneath criticism.

The war has brought two excellent publications into view, the "Military Map of the Island of Cuba," issued by the War Department, in eight sheets, scale 1:250,000; and the smaller "military map of Cuba," in four sheets, scale 1:500,000 (about eight statute miles to the inch), also prepared in the Military Information Division of the War Department, and published by Julius Bien & Co., of this city. The information on this map is so detailed that any military campaign on the island may be intelligently followed by the general reader with its aid. It gives a good idea of topography and shows the footpaths and wagon roads as well as the few railroads. The same firm has issued an excellent map of the Philippines on a large scale mainly from Dutch and British sources.

The Botany of Alabama.—Dr. Charles Mohr, of Mobile, has for years been engaged in an investigation of the Botany of Alabama under the auspices of the State Geological Survey. One of

the results of his work is a volume now going through the press giving the complete flora of the State. This will be followed by a companion volume in which the useful and the noxious plants will be treated in a very thorough manner.

Climate and Commerce.—Mr. R. DeC. Ward gives an illustration in *Science* (No. 175) of the control of climate over commerce, and the modification of this control through human ingenuity. The closing of the large ports of Russia and Siberia by ice during the winter has been one of the serious drawbacks in the development of their import and export trade. But by means of huge steam rams it is now found possible to keep open many of the important harbors throughout the cold season. Vladivostok has a steam ram which keeps the ice from interfering with the utility of the harbor throughout the winter. The port of Hangö, in Finland, is also kept open by a steam ram, and Admiral Makarof, of the Russian Navy, thinks it perfectly feasible to maintain communication through the winter between the sea and the port of St. Petersburg.

Ice-breakers seem to offer equal advantages in Canada. The *Canadian Gazette* of Feb. 24th reports that an ice-breaker, constructed to run between Port aux Basques, the terminus of the Newfoundland Railroad, and Sydney, Cape Breton, has, pending the completion of the line, been put on the route from Placentia to Sydney, and has been running since November with unfailing regularity, breaking with ease through fifteen inches of solid ice, and keeping open the port of Sydney, which hitherto has been closed in winter.

## EUROPE.

A Place of Refuge for Sealers in Barents Sea.—The *Izvestia* of the Russian Geographical Society reports (No. 4, 1898) the results of the expedition, sent in 1896 by the Hydrographic Department, to Novaya Zemlya to learn if good anchorage ground and a site for a settlement might be secured at Kostin Shar, the strait separating the south-west coast of the south island of Novaya Zemlya from Mezhdusharsky Island. A station there, it was believed, would stimulate the sealing and eider-down industries, the Government designing evidently to supply a place of succor and refuge similar to our station for the whaling fleet at Point Barrow. Bielusha Bay, penetrating the main land and near the west end of Kostin Shar, was selected and the place chosen for the station was named Samoyed. The place is easily reached from the ocean, and vessels surprised by storms on the inhospitable south-west shores of Novaya Zemlya may always find shelter there.

The Founder of the Imperial Russian Geographical Society.—The geographers of St. Petersburg have been celebrating the one hundredth anniversary of the birth of Count F. P. Lütke, who founded the Russian Geographical Society in 1845. His explorations in Novaya Zemlya and his geographical and other scientific observations during his trip around the world (1826–29) made him well known, and during his later life in St. Petersburg he was prominent in the circle of Russian men of science, who were wont to meet at the residence of one or another of the members for informal exchange of ideas on scientific topics. This circle of learned men came to be known as the "Academical Club" and, in its meetings, originated the idea of the Russian Geographical Society, which was realized by Count Lütke. The *Izvestia* says that the young Society had a hard struggle at first and its final success was mainly due to Lütke's energy and his accurate conception of the lines of practical usefulness along which it should labor. He was president of the Society and the later years of his life were largely devoted to its interests. He died in 1882, in his eighty-fifth year.

Recent Growth of the Po Delta.—The fact is well known that the Adriatic formerly extended farther to the west and at that time Ravenna and Adria were maritime towns, though now they are several miles from the sea. The recently calculated area of Italy shows an increase of land between Porto Buso, on the Austrian frontier and parallel of 44° 20′, north of the mouth of the Savio, of not less than 29.83 square miles, as compared with the measurement of 1884. With the object of ascertaining exactly where the extension of area has taken place, Professor Marinelli drew the line of the coast, as shown on the sheets of the new map, on that of 1883, and measured the enclosed areas with a planimeter. It then appeared that the movement in the outline of the coast has not been everywhere in the same direction, but that in some places the sea has gained on the land. As shown by Professor Marinelli's table (*Rivista Geogr. Italiana*, Ann. v. Fasc. 1), the total increment of land is 33.32 square miles, while the sea has spread over 3.49 square miles, reducing the gain of land to the 29.83 square miles set down above. Of this area 20.59 square miles are due to the alluvium of the Po itself.—(*Scottish Geog. Mag.*, May, 1898.)

Honors for Explorers Peary and Hedin.—The Geographical Society of London has awarded one of its two Royal medals to R. E. Peary, C.E., U. S. N., for his explorations in northern Greenland, and the other to Dr. Sven Hedin for his work in Central Asia.

Exhaustive Investigation.—A rather exceptional illustration of the exceeding minuteness with which some Continental teachers and students conduct geographical investigations is afforded by the long paper of Dr. Josef Ritter Lorenz von Liburnau in his study of the Hallstätter Lake in the Austrian Alps. The area of the lake is less than nine square kilometers, and 218 closely printed pages in the *Mittheilungen* (Band XLI., No. 1 u. 2) of the Vienna Geographical Society are devoted to a microscopic consideration of every scientific aspect of this small body of water.

## AFRICA.

Dr. H. Meyer's Expedition to Kilima-Njaro.—After Meyer and Purtscheller had conquered Kilima-Njaro, the giant of African mountains, in 1889, it was hoped that other mountaineers would endeavor to carry out more detailed exploration of this highest point in Africa. Quite a number of travellers have visited the mountain since 1889, but none has succeeded in penetrating far into the snow region, though several attempts have been made. Dr. Meyer determined, therefore, to lead another expedition to the mountain for the purpose of completing the studies of his first expedition. He will leave Leipzig in June, accompanied by Mr. E. Platz, the painter and mountaineer of Munich. Dr. Meyer will give particular attention to the exploration of the north side of the mountain, and expects to make a topographic map of that part of Kilima-Njaro. Another important purpose is to study the evidences of former glaciation on the mountain. Several explorers in tropical South America, among whom are Sievers and Regel, have made a study of glacial traces at former periods and at comparatively low elevations. Similar observations have been made in tropical Africa on Ruwenzori by Scott Elliott and on Kenia by Dr. Gregory; and it is believed that similar studies on the greatest of African mountains will yield important results. Dr. Meyer will also give attention to the distribution of Alpine animal and vegetable life.—(*Petermanns Mitteilungen*, No. 4, 1898.)

## DEPARTURE OF THE "WINDWARD."

About July 1st Civil Engineer R. E. Peary, U. S. N., will sail in the steam yacht *Windward* with an expedition which has for its avowed object the discovery of the North Pole.

To this task, which so many have set for themselves and which none have accomplished, Mr. Peary brings the ripest and most extended experience which has ever been brought to bear upon this problem.

During the twelve years which he has devoted to Arctic discovery and exploration his successes have come from the energetic execution of bold plans carefully laid, and though the results attained have been almost unparalleled, they have been reached without loss of life and without extraordinary hardship.

His failures, on the other hand, have overtaken him when he departed from his own clear and logical plans.

In the *Windward* Peary will, after coaling at Sydney, C. B., push on to Inglefield Gulf, his former headquarters, where he will take on board six or eight families of Eskimos—all picked individuals—together with a large supply of walrus meat, to be used later as dog food. Then steaming through Smith Sound, Kane Basin, Robeson and Kennedy channels, he will endeavor to reach Sherard Osborn Fjord, where the *Windward* will land him with his surgeon, his colored man Matthew Henson and his band of Eskimos, with dogs, sledges, equipment, etc., etc.

The ship will then come home if she succeeds in escaping the ice floes, or, if nipped, will winter in the ice wherever caught and come south in the Spring of 1899.

It is understood that while Sherard Osborn Fjord is Peary's objective point at present, he will, if the ice-conditions admit of it, steam still farther north before disembarking, or, if the season is against him, he may be forced to send the ship back before reaching Sherard Osborn Fjord.

Wherever he may land he will at once begin his journey northward, travelling Eskimo fashion with all his household goods on a dog-sledge. In fair weather he will advance steadily along the coast, travelling by the light of the stars and moon, sleeping sometimes in tents, sometimes in snow houses, sometimes in the open under the lee of his sledges.

In this way he hopes to reach the northernmost extremity of Greenland in the early summer of 1899. Then with a band of seasoned companions and trained dogs from which to select the fittest, he will equip a small compact party and start over the sea-ice toward the Pole, hoping to reach that point and return to the land before winter begins again.

Returning southward during the winter of 1899–1900 he will, if necessary or advisable, follow his old route over the ice-cap to Inglefield Gulf.

If the summer of 1899 should prove to be unfavorable, either in weather or in ice-conditions, Peary will establish his Eskimo colony at the northern end of Greenland and, if necessary, wait for the summer of 1900 or 1901.

In the meantime the *Windward* will go as far north as possible each summer, and leave fresh supplies at certain pre-determined points.

This, in brief, is Mr. Peary's plan. Of the men and equipment selected to carry it out it may be stated that every man, as well as every article of the outfit, might justly be stamped: "Tried and found to be satisfactory."

Beginning with the ship, we have the staunch sealer presented to Mr. Peary by Alfred G. Harmsworth, Esq., of London. In her famous trips to and from Franz Joseph Land in connection with the Jackson-Harmsworth Expedition the *Windward* established her reputation for solidity.

To command so worthy a ship Mr. Peary has secured the services of an equally worthy master. Capt. John Bartlett, of Newfoundland, took the Bradford-Hayes Expedition north in the *Panther* as long ago as the sixties, and since 1895 he has been ice-master on the Peary expeditions of 1895–96 and '97.

The surgeon will be a new man, but Henson is second only to the Eskimos in experience of arctic life and methods of travel.

In the way of equipment and supplies Peary carries no superfluous material, but only such articles as he has found by previous experience to be reliable and of value.

His plans command the approval of all good judges, and he sets forth upon his enterprise with the heartiest good wishes.

E. D.

## MAP NOTICES.

Since the publication of the last Bulletin, the U. S. Geological Survey has issued seven additional sheets of the United States atlas. Of these, one in southern New Hampshire, known as Monadnock, represents an area of 15″ square, upon a scale of 1:62,500, with a contour interval of 20′. It is a part of the hill country of New England, where the work of erosion has not progressed nearly as far toward producing a peneplain as near the coast. Many isolated hills, differing greatly in altitude, are scattered over this area, among them Mount Monadnock, the highest in the neighborhood, which occupies a central position upon the sheet. The effect of the recent elevation and tilting of this region is shown in the cañons of many of the streams, while the still more recent invasion of the land by ice is shown in the abundance of lakes and ponds, waterfalls and rapids, and irregularities in the courses of the minor streams.

In New York are two sheets, Newcomb and Olean, the former in the Adirondacks, and the latter in the southwestern portion of the State. Both are on a scale of 1:62,500, with a contour interval of 20′. The first represents an area very similar in its physiographic features to that above described, being a region of isolated, broken hills or monadnocks, as they have been denominated by Davis, with the streams flowing mainly in deep, newly cut cañons, consequent on the recent tilting and elevation of the land, with an abundance of lakes, ponds and swamps, rapids and falls, due to the erosive action of the continental glacier.

The Olean area is a portion of the great Alleghany plateau, the westernmost member of the Appalachian mountain system, a region which was base-leveled upon a surface of a bed of hard, carboniferous sandstone, thus forming a plateau. This was raised and tilted, the tilting here being toward the west, and the subsequent erosion has gone so far as to produce deep, narrow valleys along the streams, but has had little effect upon the general level of the plateau.

In South Dakota is one sheet, Parker, representing an area of 30″ square, upon a scale of 1:125,000, with a contour interval of 20′. In the main its surface has been produced by the deposits of the great continental glacier, the southwestern part being occupied largely by an arm of the Coteau des Prairies, a plateau-like deposit of morainal material rising some 200′ above the general level. The

principal streams, Vermilion and James rivers, have been in existence so short a time that they have done but little erosion; the latter stream having cut its bed only about 100′ below the general level of the country. The region abounds in swamps and lakes without outlet, the result of glacial occupation.

In Nebraska are two sheets, Grand Island and Camp Clarke, both upon a scale of 1:125,000 and with a contour interval of 20′. The former includes a portion of the valley of Platte River, here having a breadth of upwards of 20 miles, almost as level as a billiard table. The river is represented as at low water, consisting of a number of petty trickling streamlets scattered widely over its bottom. Southeast of the river the land rises in low bluffs covered with sand hills, in which are numerous sinks. The divide between the waters of the Platte and the Republican is here within a mile or two of the former stream.

The Camp Clarke sheet represents an area in western Nebraska traversed by North Platte River, which here, even at the time of low water, is a bold stream, having a width of fully half a mile, flowing through a bottomland five or six miles in width. North of it the country rises brokenly to a high prairie five hundred feet above the river. Much of its summit is covered with small sand hills, which make the soil valueless, except for purposes of grazing. South of the river, and separating it from Pumpkin Creek, are soft sandstones, highly eroded, forming bad lands. Many of the curious rock forms in this region are well known as landmarks, among them Chimney, Castle and Steamboat rocks. South of Pumpkin Creek the land rises gradually and then abruptly to a high prairie, similar to that upon the north side of the Platte.

In California is one sheet, Mount Diablo, upon a scale of 1:62,500, and with a contour interval of 50′. This sheet represents an area in the coast ranges east of the Bay of San Francisco and south of Sacramento River.

A special map has been published of the surroundings of Hot Springs, Arkansas, upon a scale of 1:62,500, with a contour interval of 20′. This presents in much detail the peculiar sinuous ridges of the Ozark hills.

The war with Spain continues to furnish a stimulus to map publishers. Among the useful maps to which attention may be called is that published by the Hydrographic Office, U. S. N., entitled "The Island of Cuba," on a scale of 10 miles to 1″. This map, although upon a much smaller scale than that of the War Department, noticed in our last number, has the advantage of exhibiting at once not only the land features, but the depths of water, both off shore and in the harbors.

H. G.

"*Our New Colonies—Cuba, Porto Rico and the Philippines, J. L. Smith, Philadelphia, 1898.*" This is a popular and cheap map, combining representations of all these islands upon one sheet.

It is astonishing how completely all interest in the gold fields of Alaska has disappeared, and it is, therefore, with a feeling akin to surprise that we are recalled to it by receiving the "Yukon Map." This map, in ten sheets, represents all that is known of the country from Cook Inlet, by way of the several Yukon trails to the United States boundary on the Yukon; the scale, 6 miles to 1", 1898, prepared and published by the General Surveyor's Office, Department of the Interior, Ottawa. Relief is expressed by sketchy contours and by crayon shading. H. G.

*The Century Atlas of the World, prepared under the Superintendence of Benjamin E. Smith, A.M., Century Company, New York, 1897. 4to. Map Plates 117, with Indices.*

The question is often asked, "What is the best atlas of the world?" While it may not be strictly correct to answer "The Century," certainly this is as good as the best, especially for American use. Of the whole number of plates, 53, or nearly one-half, are devoted to the United States, 5 to Canada, 9 to Central and South America, 27 to Europe, 9 to Asia, and an equal number to Africa and Australia together. The remainder of the Atlas is devoted to historical maps of Europe, Asia Minor and the United States, and to physical maps of the world.

The maps are well executed, clear, legible, leaving little or nothing to be desired on that score. They are thoroughly up to date and sufficiently full of detail for all ordinary requirements. The maps are well indexed. H. G.

*Physiographic Types, by Henry Gannett. Topographic Atlas of the United States. Folio 1, U. S. Geological Survey, Washington, D. C., 1898.*

We welcome Folio 1 of the Topographic Atlas of the United States, recently published by the United States Geological Survey, for it marks a distinct step in advance in educational geography. Hitherto the teachers of physiography in High Schools, Academies and Colleges have been unable to make the best use of the valuable maps of the United States Geological Survey, because not readily available, and because when secured no adequate descriptive text accompanied the maps. Now we have a selected series of ten maps, representing typical and simple land forms of the United States,

brought together in one folio, with good text descriptions. Furthermore, the folio is uniform in size and style with the geological folios, a matter of help to librarians and teachers having to care for large collections.

The folio opens with a summary of the history of map making by the United States Geological Survey, followed by a description of a topographic map, under the headings, scale, sheets, contents, water features, culture and land features. The sheets selected for description are the following: Fargo, North Dakota-Minnesota; Charleston, West Virginia; Caldwell, Kansas; Palmyra, Virginia; Mount Shasta, California; Eagle, Wisconsin; Sun Prairie, Wisconsin; Donaldsonville, Louisiana; Boothbay, Maine; Atlantic City, New Jersey. "The ten sheets here described illustrate the operation of water and ice in the production of topographic forms, under simple conditions. The first three show different stages of progress in aqueous erosion—the beginning, middle, and a late stage. The fourth sheet shows how the process of aqueous erosion, having been carried far toward completion, may commence again. The fifth sheet shows the growth of a volcanic mountain and the commencement of its destruction. The sixth and seventh sheets illustrate glacial deposition; the eighth, river deposition; and the ninth and tenth, the formation of coast lines."

The examples selected are simple, clear and extremely valuable. Although primarily for use in the secondary schools and colleges, we know from experience that many of the maps can be made of great value in the graded schools. For instance, the Donaldsonville sheet, selected to illustrate river flood plains, will, when carefully studied, give children of eleven and twelve years ideas of the possibilities of floods and their effects such as any amount of reading would not so emphasize.

To be of greatest service the maps must, however, be studied individually at desks, for topographic maps cannot be used readily as wall maps.

We are glad to note that a second folio on the Physiography of Texas is in press, and a third under way. We hope that the response of teachers and superintendents may warrant the continuation of the series, and that these folios may soon be found in all our best schools.

The folio thus reviewed may be secured for twenty-five cents from the Chief Clerk of the U. S. Geological Survey, Washington, D. C. R. E. D.

## BOOK NOTICES.

*Northward Over the "Great Ice." A Narrative of Life and Work along the Shores and upon the Interior Ice-Cap of Northern Greenland in the Years 1886 and 1891–1897. With a Description of the Little Tribe of Smith-Sound Eskimos, the most Northerly Human Beings in the World, and an Account of the Discovery and Bringing Home of the "Saviksue," or Great Cape York Meteorites. By Robert E. Peary, Civil Engineer, U. S. N., Member of the American Society of Civil Engineers, Member of the American Geographical Society. With Maps, Diagrams, and About Eight Hundred Illustrations. In Two Volumes. New York. Frederick A. Stokes Company. MDCCCXCVIII.*

In the author's words, this narrative has been written to supply a complete authentic record of his Arctic work—a record which he owed it to his family, his friends and himself to put in permanent form.

The narrative covers the reconnaissance of the Greenland Inland Ice in 1886; the thirteen-months' sojourn in North Greenland in 1891–92, including the twelve-hundred-mile sledge journey across the ice-cap and the determination of the insularity of Greenland; a twenty-five months' stay in North Greenland in 1893–95, with a second 1200-mile sledge journey over the ice-cap, the completion of the study of the Whale-Sound natives, a survey of that region and the discovery of the Cape York meteorites; and the summer voyages in 1896 and 1897, with the story of the removal of the 90-ton Cape York meteorite.

Mr. Peary recognizes in the fullest sense his obligation to the Societies and to the friends, who have stood ready through twelve years to help him with influence and with means, and to the Government which has kindly given to him the leave of absence for his Arctic work; but he rightly calls attention to the fact that his work has been accomplished by private enterprise, and that fully two-thirds of the total cost have been furnished by himself. Single contributions from other sources have never exceeded $1,000, except when Mr. Morris K. Jesup, President of the American Museum of Natural History, bore the principal burden of the expedition which brought back Peary and his two companions in 1895.

It is not to be doubted that the idea of utilizing the Inland Ice as a road for overland sledge journeys belongs to Mr. Peary, and that he has introduced the design for winter quarters, the use of the odometer, the barograph and thermograph, and has shown that the explorer in the Arctic may dispense with the sleeping-bag.

Even those, who do not feel the attraction of his main subject, must take a deep interest in Mr. Peary's account of the Eskimos of Cape York, that isolated community of 253 persons, the outpost of the human race in the far North.

The effect of his expeditions upon the comfort of these people is strikingly put:

> Seven years ago, many a man in this tribe possessed no knife, and many a woman no needle. Few of the men possessed kayaks, or skin canoes; and he was indeed well off who had a spear- or harpoon-shaft made of a single piece of wood. To-day, men and women are amply supplied with knives and needles; every adult man and half-grown boy has his canoe; most of the men have guns; and every hunter is supplied with the best of wood for his lance, his harpoon, his seal-spear, and his sledge. The effect of these improvements in their weapons has shown itself at once in an improved condition of the tribe, resulting from the great increase in the effectiveness of the hunters. The people are better clothed, they can support a larger number of dogs (their only domestic animal) and, as a result of their more ample nourishment, and consequent greater ability to withstand the constant hardships of their life, the death-rate has decreased, and the birth-rate perceptibly increased, within the past six years.

The detailed study of these Eskimos has not been attempted in this work. The chapter devoted to them (Vol. 1, pp. 479–514) presents no more than a brief condensation of the material in Mr. Peary's hands. None the less, it is full of interest.

Mr. Peary is inclined to accept Sir Clements Markham's theory concerning the Siberian origin of the Eskimos, a theory which receives some support from their physical peculiarities; and he tells us that "Miss Bill," the young girl brought to this country in 1894 by Mrs. Peary, when she met a Chinaman, ran up to him and tried to talk with him, and that members of the Chinese Legation in Washington spoke to her as to one of their countrywomen. These are incidents to be noted, but it is easy to overrate their importance and to mistake their significance.

There is no form of government among the Arctic Highlanders. Each man is supreme in his family, and each family is self-supporting. There is no marriage ceremony, and the wife is a piece of property, like a sledge or a canoe. At the same time, children and the infirm and aged are kindly treated.

They seem to have, properly speaking, no religion; but decision must be reserved on this point.

They are generally below the average stature, though some of the men are about five feet ten inches in height, and all are plump and solidly built. Their muscular development is astonishing, concealed as it is under the covering of blubber which they possess, in common with the seal, the walrus and the bear.

These children of nature have no depraved habits, no stimulants, no narcotics, no slow poisoning; or, in one word, no medicine.

They practise no mutilation. Their diseases are principally rheumatism and lung and bronchial troubles.

Contrasting these uncontaminated people with their relations in South Greenland, protected though these have been by the vigilance of the Danish Government, Mr. Peary hopes that they may be left in peace to live out the part appointed them by the Creator, undisturbed by efforts to understand the white man's ideas of God, of right and of morality.

Mr. Peary wins his reader from the beginning, with the directness and the unstudied flow of his story, already familiar in outline to geographers throughout the world, but set before them now afresh with the earnestness and the vitality of a sustained purpose.

His exploration of the Greenland ice-cap, with all its peculiar conditions, was a new contribution to the knowledge of the Arctic, and a chapter added to the history of heroic endeavour. It is not to be thought that he has said his last word; but whatever may be the outcome of the years before him, his place is already won among the simply great, the

strong in will
To strive, to seek, to find, and not to yield.

*Physiography for Beginners, and Physiography for Advanced Students. A. T. Simmons, The Macmillan Co., 1897.*

The two books whose titles are given above have to do with physiography in the English and not the American sense. They are thus largely devoted to the elements of physics and chemistry, to mathematical and astronomical geography, and very different in character from our better text books in geography for secondary schools that we have in this country. They are neither of them available for students' use in this country, because too inclusive, and because much of the subject matter would here be given in elementary courses in other subjects.

They are, however, both very suggestive to a teacher, and well worthy of adoption as reference books. The experiments are well selected, and the diagrammatic illustrations very suggestive and to the point. In some cases the arrangement and plan of development

might well be questioned as to the pedagogical value. For instance, a much better treatment of the ocean currents would be to give first the paths of the currents as they must be in a general way on a rotary globe, with the axis inclined 23½ degrees. The actual condition in each ocean could then be compared with the conditions determined by the position of the planet in space, and thus each ocean would not be a unit. In the same way we miss the more scientific classification of winds as given in our better text books, and the more modern conception of that difficult problem of the "tide opposite the moon."

The books are much more mathematical and exact than the books of a similar character with which we are familiar, and might be made the basis for some very carefully planned and accurate laboratory work in the field they cover. We wish that some of the manner of treatment adopted by Mr. Simmons might be followed more extensively with us. R. E. D.

*Geography in the Educational System of Great Britain.*

In 1885, Dr. J. Scott Keltie, now Secretary of the Royal Geographical Society of London, and editor of the *Geographical Journal*, presented to the Council of the Society a very full and careful report on the position of geography in the educational system of Great Britain. This report marked a great step in advance in geography teaching in Great Britain, and has been the ultimate reference book on the subject since.

At the Toronto meeting of the British Association in 1897, a committee of six presented a long report, based on Dr. Keltie's earlier labors, and bringing the matter of geography in education up to date. The report was mainly prepared by the Secretary of the Committee, Mr. Andrew J. Herbertson, of Heriot-Watt College, Edinburgh, and deserves careful reading by all interested in the subject. It covers 38 pages in the report of the British Association for 1897.

The report considers the subject of geography in all grades of educational work, and contains illustrations of syllabi and examination papers. It is very interesting to note that one of the generalizations made by the Committee is in reference to the failure of most pupils to gain knowledge of geographical *principles* from their school work. This failure is unfortunately very widely true in this country also. R. E. D.

# ACCESSIONS TO THE LIBRARY.

## May–June, 1898.

### BY PURCHASE.

London Street Names, by F. H. Habben, Philadelphia, 1896, 8vo; Notes on the Nicaragua Canal, by Henry I. Sheldon, Chicago, 1897, 8vo; The Navigation and Voyages of Lewis Wertomannus, etc., 1503, translated by Richarde Eden, Edinburgh, Aungervyle Society, 1884, 8vo; Military Map of Puerto Rico, 1898, War Department, Washington (New York), 1898, sheet; The Naturalists' Directory, by S. E. Cassino, Boston, 1898, 16mo; The Journal of Jacob Fowler, etc., edited, with Notes, by Elliott Coues, New York, 1898, 8vo; Archæological Survey of India, Reports, Vols. 1–23, and General Index, Simla and Calcutta, 1871–1887, 24 vols., 8vo; Journal ou Description du Merveilleux Voyage de Guillaume Schouten, etc., Amsterdam, 1619, 4to; Travels through the Western Country in the Summer of 1816, by David Thomas, Auburn (N. Y.), 1819, 12mo; Biographies of Words and the Home of the Aryas, by F. Max Müller, London, 1888, 8vo; Voyage à Constantinople, etc., par Boucher de Perthes, Paris, 1855, 2 vols., 12mo; Map of the Philippine Islands and Adjacent Seas, New York, 1898, folded in book; Trinidad and the Other West India Islands and Colonies, by Daniel Hart, Trinidad, 1866, 8vo; History of the Gipsies, by Walter Simson, edited by James Simson, New York, 1866, 12mo; The Azores: or Western Islands, by Walter Frederick Walker, London, 1866, 8vo; The Punjab and Delhi in 1857, by J. Cave-Browne, Edinburgh, 1861, 2 vols., 8vo; Borneo and the Indian Archipelago, by Frank S. Marryat, London, 1848, 8vo; Les Races et les Nationalités en Autriche-Hongrie, par Bertrand Auerbach, Paris, 1898, 8vo; Cinq Mois au Pays des Somalis, par le Prince Nicholas D. Ghika, Bale et Genève, 1897, 8vo; American Annals, or a Chronological History of America, by Abiel Holmes, Cambridge, 1808, 2 vols., 8vo; Life and Adventures of Peter Wilkins, by R. S. (Robert Paltock), Boston, 1833, 32mo; Harem Life in Egypt and Constantinople, by Emmeline Lott, Philadelphia (s. a.), 16mo; The World in Miniature, Illyria and Dalmatia, edited by Frederic Shoberl, London, 1820, 2 vols. in 1, 12mo; Description of Latium (by Cornelia Knight), London, 1805, 4to; New Geographical Dictionary, etc., London, 1738, 8vo; The Jesuit Relations and Allied Documents, edited by Reuben Gold Thwaites, Vols. XIX, XX, Cleveland, 1898, 8vo; The Archer and the Steppe, by F. R. Grahame, London (1860), 8vo; The Riviera, by Hugh Macmillan, London, 1892, 8vo; The Travels of a Hindoo to Various Parts of Bengal and Upper India, by Bholanauth Chunder, London, 1869, 2 vols., 8vo; Carthage and the Carthaginians, by R. Bosworth Smith, London, 1878, 8vo; Mohammed and Mohammedanism, by R. Bosworth Smith, 2d edition, London, 1876, 8vo; Narrative of an Official Visit to Guatemala from Mexico, by G. A. Thompson, London, 1829, 8vo; Lands of the Slave and the Free, by H. A. Murray, London, 1857, 8vo; Sketches of Bermuda, by Susette Harriet Lloyd, London, 1835, 8vo; Northward over the "Great Ice," by Robert E. Peary, New York, 1898, 2 vols., 8vo; Considerations Sanitaires sur l'Expédition de Madagascar, etc., par le Dr. G. A. Reynaud, Paris (1898), 18mo; L'Algérie-Le Sol et les Habitants, par J.-A. Battan-

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## NOTES AND NEWS.

The Fourth Centenary of the discovery of the maritime route to India has been worthily celebrated. The Paris Geographical Society held a special Vasco da Gama meeting on the 25th of April, opened by an address from the President, M. A. Milne-Edwards. He was followed by Prof. Henri Cordier, who spoke of the Relations between Europe and Asia before and after the voyage of the great Portuguese; by Lieut. Emile Védel, who described the voyage as recorded in the *Roteiro*; and by the Marquis de La Mazelière, who took for his subject India at the Time of Vasco da Gama.

At a special meeting of the Royal Geographical Society, held on the 16th of May, the President, Sir Clements Markham, K.C.B., read a paper on The Four Hundredth Anniversary of the discovery of the Cape Route to India by Vasco da Gama.

At Lisbon the celebration was opened, May 17th, by the firing of a salute of 101 guns by the forts and ships, and a grand naval review of the Portuguese and foreign ships. The three following days were devoted to regattas, processions, exhibitions and meetings, varied by excursions to famous places, such as Cintra, Batalha, Coimbra and Oporto.

Besides the publications of the Central Executive Committee (elsewhere acknowledged), and those of the Lisbon Geographical Society and the *Revista Portugueza Colonial e Maritima*, an Album Commémoratif has been brought out in Paris by Mme. Juliette Adam, in a handsome folio, containing original poems, drawings and compositions, literary and musical, by François Coppée, Vice-Admiral Gervais, Carolus Duran, Puvis de Chavannes, Saint-Saëns, Sully-Prudhomme, Pierre Loti and others.

Another work forms a more permanent contribution to the literature of the Centenary. This is Mr. E. G. Ravenstein's translation of the *Roteiro*, issued by the Hakluyt Society, as No. XCIX. of their series. In this the editor has added translations of the letters of King Manoel and Sernigi and of three Portuguese accounts of da Gama's voyage. His Introduction and Notes are very valuable, though the reader learns with surprise (*Introduction*, *p. XV.*) that Magellan was a renegade Portuguese, and that the feminine form of the Latin adjective *vetus* is *veta* (*Introduction*, *p. XXV.*)

The *Université Nouvelle de Bruxelles* founded, on the 18th of March of this year, a Geographical Institute and adopted a plan of instruction comprising a Preparatory Course in the elements of science, of history, of languages and of drawing, and a three years' Higher Course, with excursions during the vacations. The Institute expresses the wish to establish relations with geographical societies. Communications are to be addressed: au Secrétariat général de l'Université Nouvelle, rue des Minimes, 21, à Bruxelles.

The Siebenbürgischer Verein für Naturwissenschaften, at Hermannstadt, announces the death, on the 26th of May, of Dr. Edward Albert Bielz, one of the founders and for many years presiding officer of the Verein.

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# THE UNITED STATES MID-PACIFIC NAVAL SUPPLY STATION.

BY

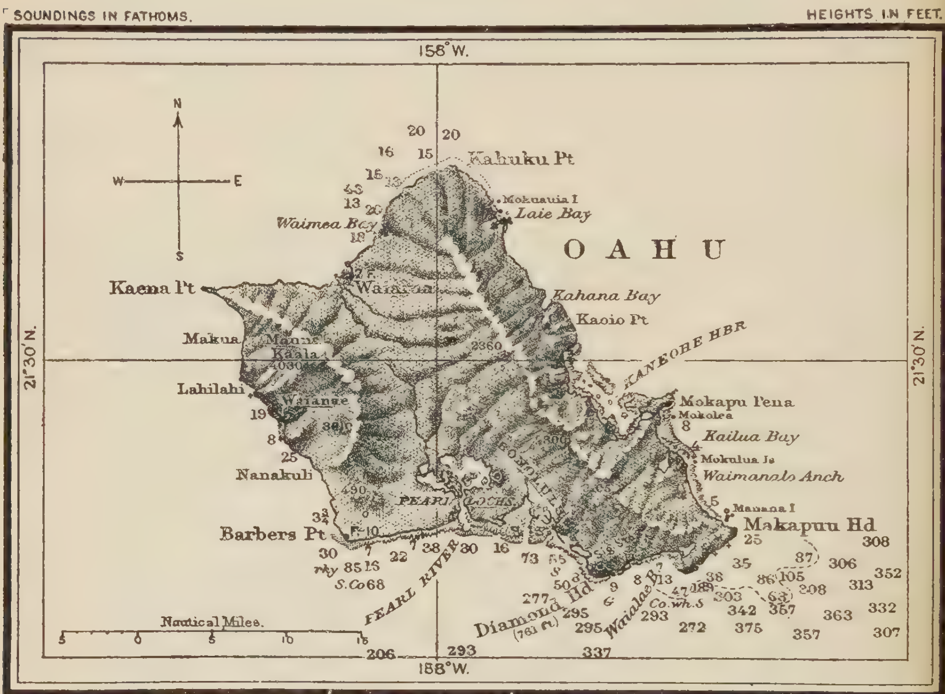
G. W. LITTLEHALES.

There is a valley in Oahu, stretching throughout the island's short length of twenty miles from the ocean on the north coast to the ocean on the south, and bounded on the east and west sides by knife-edged mountain ridges rising to a height of about 3,000 feet. At the northern end of this gorge-like valley, on the ocean edge of the almost level plain into which the ridges of the interior die out in approaching the sea, is Waialua, a port and centre of population of considerable importance in the Hawaiian Islands; at the southern end of the valley, the subsidence of the volcanic mountain, whose top has become the island of Oahu, has brought about the burying of the lower courses of a river, causing the waters of the ocean to flow inward through the river channel and form an irregular expanse of water known as Pearl Lochs. The general depth of the waters of the Lochs is about 50 feet, but the Pearl River, which is the narrow channel leading to the sea, is in general almost twice as deep, except at the seaward entrance, where a bar, running across the channel even with the outer edge of the coral reefs that fringe the coast, rises to within 10 feet of the surface.

This bar was a weighty element of consideration in all the investigations and discussions that took place with reference to the establishment of a United States Naval Supply Station in Pearl Lochs in the decade preceding the ratification, in 1887, of the Convention of 1884 between the United States of America and His Majesty the King of the Hawaiian Islands, in the second Article of which "His Majesty the King of the Hawaiian Islands grants to the Government of the United States the exclusive right to enter the harbor

of Pearl River, in the Island of Oahu, and to establish and maintain there a coaling and repair station for the use of vessels of the United States, and to that end the United States may improve the entrance of said harbor and do all other things needful to the purpose aforesaid."

There had been surveys by the officers of the U. S. S. *Kansas* in 1873, of the U. S. S. *Pensacola* in 1875, of U. S. S. *Vandalia* in 1887, which gave complete information about the physical characteristics of Pearl Lochs, but, as far as they touched upon an examination of




the formation of the bar, they gave rise to the general belief that both at Pearl River Entrance and at Honolulu, which lies five miles to the eastward, the coral reef that skirts the south side of Oahu extended across the entrances to form solid coral bars. Notwithstanding the anticipation of extensive submarine blasting operations to remove the bar, public opinion clung to the Pearl River region on account of its magnificent capabilities for military defence. In 1892 the Hawaiian Government undertook operations for the removal of the bar at Honolulu and, contrary to the prevailing opinion, found that there is a deep channel filled with sand passing

through the fringing reef of the coast and leading into the basin known as Honolulu Harbor.

This discovery immediately gave rise to the supposition that the Pearl River bar is also composed of sand, and that, therefore, the question of opening Pearl Harbor might be disposed of without undertaking formidable and expensive work. The entrance to Honolulu was deepened from 21 to 30 feet. The whole work was performed in a short space of time by a suction-dredge which pumped the sand from the bar and discharged it behind a retaining wall built upon the reef at the edge of the harbor. Rear-Admiral J. G. Walker set the matter at rest in June, 1894, while commander-in-chief of the Pacific Station, by causing a proper examination of the Pearl River bar to be made by an expedition from his flagship, the *Philadelphia*. They made twenty-eight borings on the bar to a depth of 30 feet below the surface of the water and found nothing but coral sand which had been washed in between the entrance-walls formed by the coral-reef. Lieutenant W. M. Wood, one of the most observant and successful of the surveyors that have been engaged upon the Pearl River bar, reports as follows with reference to the manner in which the sea breaks upon the coast at Pearl River: "It appears that the prevailing local swell setting on this bar is caused entirely by the trade-wind and is more or less heavy according to the strength of the trades. It approaches the bar well from the southward, evidently being materially changed in direction as it sweeps around the eastern end of Oahu. Hence on the bar the wind which causes the swell crosses the latter nearly, if not quite, at right angles to the direction of its progress."

This is a most important observation for him to have made, for in it lies the information that is necessary to explain how the Pearl River entrance came to be filled with sand. The waves of this coast do not approach the land with the line of breakers parallel to the beach, but from the southeastward in a direction slanting toward the beach. Breaking on the eastern headland of the entrance to the river they carry the coral-sand, with which they become laden in their shoreward passage, as far as possible toward the west and then, when their force is spent and the sand is deposited, they slip back into the sea under the force of gravity and by the line of shortest descent.

A look at the accompanying chart will show that the most commodious anchorage is that in East Loch, lying north of Ford Island. It is about half a mile wide and a mile long within the eighteen-foot curve. There are other places where a ship can anchor, but a large

ship would have little room to swing. In the reports of twenty years ago upon the suitability of the harbor for naval purposes there was generally to be found a declaration that the place is commodious, but what was regarded as commodious by the commanders of the navy of twenty years ago has come to seem contracted for the manœuvring of the huge ironclads of to-day, and it is doubtful whether the full measure of the expectations of the past can ever be realized in a dockyard on Pearl Lochs.

A final and thorough hydrographic survey of Pearl River and Lochs was made by the officers of the U. S. S. *Bennington* between August and December, 1897, and from the standpoint of the navigator this harbor is probably better known than any other of no greater commercial importance. Since the Hawaiian group has been annexed to the United States public attention has ceased to be centred upon Pearl Lochs, because all the advantages that were sought there are already present in a developed state at Honolulu.

# GEOGRAPHIC CONDITIONS THAT MAKE GREAT COMMERCIAL CENTRES.

BY

MAJ. ALFRED F. SEARS, C.E.

The student of American history will be struck with one remarkable, overtowering fact, which is that the men who inaugurated civilization upon this western hemisphere did not attempt to transplant here the old life of Europe, but from the very beginning, whether wittingly or otherwise, made this in truth morally and politically a new world. The result has been that principles, which seemed established for the stability of earth, have presented themselves here as problems to be wrought to a solution with travail and expense of gold.

If the problem about to be discussed ever appeared as such in the Old World, it was settled ages before this continent was known to the civilization of Europe. But the European had never formulated the principles on which he established commercial ports, and if he had, the American would have ignored the equation, declaring that the elements being different on this side the globe, the results must be different. The American, like all youth, would insist on his own experience to discover that there are natural laws of commerce, the same the world over, the only difference being that in a wide, sparsely settled territory, like the United States, the ramifications of trade are more extended and therefore more attenuated.

The business of the world is done at centres of exchange. These centres in our country are the cross-roads grocery and variety store; then the knot of a half-dozen larger establishments, surrounded by a few dwelling houses, a church, a school-house, a post office, and to-day a liquor saloon and railroad station. A large village follows, called perhaps a country town, to which many hamlets are tributary; and the shire town, larger than any yet mentioned and containing all their advantages, with the court-house of the county, possibly a saw-mill and some manufacturing establishments. After that comes the commercial port of the region.

Without reflection, it would seem natural that all the smaller establishments should make towards the coast, and that the commercial port of a region would be the nearest of all to the great highway of nations; that the nearer the ocean a good harbor can

be found, the better the prospect for building the commercial centre of exchange of any region.

On account of the influence of railroads and capital in rooting out old stage stations and building up some prairie towns or manufacturing and suburban villages, it has come to be believed that these agencies are able to control the fortunes of whatever place, and are all that are requisite to bring new cities into being and maintain them in prosperity.

Our Atlantic coast is strewn with ruined hopes in the shape of stillborn cities, having excellent harbors and abundant water front, of which the only *raison d'être* is superior facility of access from the ocean.

There has been abundant honesty of purpose in the design and no excessive credulity in the investment; but there does appear to have been a failure to comprehend and appreciate the laws of trade affecting the project. It becomes, therefore, a proper study to ascertain if capital is justified in assuming to force the solution of so important a problem, and whether there is not involved as superior to capital a natural law, the elucidation of which shall aid in the settlement of these questions.

As the investigation proceeds, the problem undertaken appears so clear and the conclusions so natural and just that one is almost deterred by their simplicity from stating them so formally. But, when we reflect that however clear and natural and just the truth seems to be, many of the wisest men of affairs are constantly failing in this field, we recognize the necessity for such a statement as shall make it not only positive, but tangible, and remove, so far as we are able, a certain class of speculation from the region of chimera to a field of certainty.

More than a half-century ago, when the pioneer steamer of the Cunard line entered Boston harbor, the merchants of that enterprising town felt assured of commercial triumph in the race with New York, because they were twenty-four hours nearer Liverpool than their sister. Some not too "wise men of Gotham" were alarmed, and wondered if they had not committed an error when they settled in the Dutch metropolis, although the population of New York was 300,000 and Boston contained less than a third of that number. To-day New York is the centre of a population of 5,000,000 and Boston of somewhat less than a million. A steamer leaves New York daily for Europe, and another sails once a week from Boston. To the wonderment of the Boston merchants, New York and not Boston has become the commercial metropolis

of the country. In those days, Boston boasted the two or three wealthy men of America. A Boston bank note was as current all over the country a half-century ago as a national bank bill of the present day. This could never be said of the banks of New York, nor of any other city in the United States. The Boston business man figured up the situation logically, as it appeared on the surface of things, quite in his favor. He said: We have the American port nearest Europe by twenty-four hours; an excellent harbor covering one hundred square miles; we have enormous capital and can offer trade every facility it demands; we have the most intelligent population, the purest municipal government in the world; the highest reputation for commercial probity and honor; all this with business liberality and enterprise. "The Solid Men of Boston" stood for a commercial proverb. Nevertheless, New York has pushed ahead, and no amount of money expended to tap by a short route the western country north of New York, or to draw traffic directly from New York by shorter railroad lines, has yet effected the object of the projectors or is likely to effect it.

On investigation, this result appears in harmony with a natural order, independent of the enterprise, wealth and character of merchants. New York is more than 200 miles nearer the heart of the country than Boston. This it was made her advantage. The moving mass that seeks transportation reckons that distance to be as nothing on the ocean compared with the cost of movement on land or river. The cargo of a great steamer transported between New York and Boston fifty years ago, would have demanded the service of ten locomotives and four hundred cars, with all the cost of transshipment. On board the ocean steamer it represents only the comparatively inexpensive continuance of her voyage for another half day.

New York and Boston are not unique examples of such a relation of things. Going south we find that every commercial port of the country has been made the mark of an ambitious rival, under the mistaken apprehension that an error was committed in the original location.

Thus, Philadelphia, on the Delaware, 120 miles from the ocean, has grown into grand proportions, and continues to grow, in spite of the desperate exertions of the two or three ports greatly nearer the highway of nations. Commerce refuses to be persuaded to avoid a tedious navigation against the chances of head winds in a narrow roadway, and avail itself of a port easy of access in the lower bay.

Another instance of the perversity of commerce in passing by great advantages to get up stream is witnessed in the position of Baltimore, 108 miles from Hampton Roads.

Continuing along our southern coast, circumstances of the Civil War led to the development by northern capital of one of those enterprises on that coast, that was to revolutionize the commerce of the region and destroy the two old cities of Savannah and Charleston. A harbor nearer the sea and accessible to vastly greater ships than can enter Charleston was found at Port Royal, of which, the Encyclopedia says, "its harbor is one of the finest in the world," and this, it was believed, would drain both those towns of their wealth and population. Capital seized the point and tapped the neighboring country with its railroad. Streets, wharves, warehouses, corner lots and advertisements flourished for a time. New York was to be supplanted by a great seaport, towards which all the trade of the South, with its immense treasure of cotton, was to rush for direct shipment to Europe, without the intervention of fearful Wall Street and a cotton exchange on a strange soil. Port Royal was to be like the focal centre of a folding fan, towards which all the ribs pointed from the plantations of the entire grand Southern territory. But, after thirty years of struggle, Port Royal is a dull shipping point, with a negro population of about 1,000, a sort of back door to the cities it was designed to obliterate; and Savannah and Charleston remain live cities.

For twenty-five years capital struggled to build a commercial city at Brunswick, Ga., in rivalry to Savannah. The capital, the superior facilities and the twenty-two feet of water on the bar, all still exist there, but as yet no important port has arisen from their ingenious combination. To-day it is a town of palaces occupied by negro laborers.

And all this, notwithstanding the fact that both cities—Savannah and Charleston—must be reached from the ocean, by crossing bars that give inferior facilities, both as to safety and depth of water, to those offered by the new enterprises.

It will presently appear that in these as in all other cases the effort of commerce is to reach the producer; to get as close to him as possible to sell the supplies the wealth of his production will permit him to buy; and to seize his produce for the profit of its marketing.

And still, continuing along the southern coast, we come to another similar project for building up a commercial city at Fernandina, Florida. In its ambitious progress towards this great

future it would destroy the value of Jacksonville, then occupying the envied relation to an extensive territory, believed to be entering a promising era. The only apparent argument against such a result lay in the fact that Jacksonville had the start, by several years, and a population of 2,500 souls, among whom were counted the leading men of the State in wealth and character. But the harbor of Fernandina seemed to possess every commercial combination for the success of the scheme. It was on the inside of Amelia Island, only six miles from the bar over which vessels drawing twenty feet could pass in ordinary high tides, while Jacksonville was twenty-five miles from the ocean, and must be reached by crossing a dangerous bar on which the water was at best but twelve feet deep and often unfit for passage, by reason of the heavy rollers that broke over it whenever the wind was east of the meridian. Fernandina is the healthier of the two sites ; yellow fever dies out, when brought to Amelia Island, whereas it has twice decimated Jacksonville. A railroad from Fernandina to the Gulf of Mexico was in course of construction, and would put all the Gulf ports in close connection with a first-rate harbor on the Atlantic.

Fernandina was, moreover, a pet of the national Government. United States officers had been employed in its railroad construction and in buoying its harbor as in pushing forward the coast surveys, which should make the superior value of the port known to the world of commerce. Distinguished politicians of the dominant party controlled the enterprise; a United States Senator was its president and the Governor of the State of Florida was its home guardian. The town site and the Florida Railroad were bought by a distinguished New York capitalist; and another northerner has spent millions in railroad and canal lines in Florida, in palatial hotels and the development of winter resorts; four steamship lines run to Fernandina. One would suppose that such remarkable prosperity would have been the prosperity of the only good harbor on its coast, and that Fernandina would to-day be an important commercial city. The actual fact is that Fernandina, with its excellent harbor and magnificent intentions, contains a population of 1,800, mostly negroes, while Jacksonville, twenty-five miles up a river, and reached only by crossing the worst bar on the coast, except perhaps at Charleston, has already a population of 36,000, and is become the commercial port of the region, compelling from the national government the attention demanded for the improvement of the St. John's River bar.

Observe now that Jacksonville is in closer connection with the

centre of production than Fernandina. While this town is but six miles from the ocean, Jacksonville, on a river that extends straight in towards the interior—on a line normal to the coast—is, by the difference in distance from the sea, just so much nearer the heart of the country. A railroad from Jacksonville and one from Fernandina cross each other twenty miles from Jacksonville and fifty from Fernandina, the common point reached from the producing centre being thus thirty miles nearer Jacksonville than its rival aspirant, which being on an island is inaccessible to the wagons of the farmers, the absorbing idea of the speculating projectors being, that nearness to the ocean, good harbor facilities alone, would force the country to come to them. Jacksonville is not only nearer the same centre of production that stimulated the greed of Fernandina, it is on a river that stretches away to the south, through more than a hundred miles of fertile territory, thus bringing another producing region into facile connection with the town.

If we go around to the Gulf coast we find New Orleans one hundred miles up the Mississippi River at the head of ship navigation. This great port has crowded as close to the interior of the country as possible, when it might have been established nearer the Gulf and thus escaped the troublesome river navigation. Some years ago a railroad was built through to the coast, passing west of New Orleans, and a line of steamers established to run to the ports of the South. Morgan City still exists, with about 2,000 inhabitants, and does a sort of alley-door business for the great Southern metropolis. Mobile has a population of less than 32,000, although it is nearer the ocean, from which it is more accessible, and has excellent railroad connections. But even Mobile (as well as Morgan City) has been put at the head of the bay on which it is located, thirty miles from the Gulf, so as to get as near the producing centre as possible, $1,000,000 having been expended on the channel of Mobile Bay by the United States Government to this end. And Mobile is now, as to its accessibility from the ocean, in a better position than New Orleans, while in geographical miles it is nearer the producing centre of which New Orleans has always been and remains the commercial metropolis. Mobile has held this apparent advantage since 1875, and yet its growth in population has remained stagnant or worse, for in 1870 it contained 32,000 souls, while in 1890 there were 200 less.

It is an interesting fact and quite in the line of our argument, that Mobile has taken the trade in tropical fruit away from New Orleans. Mobile is enough nearer the fruit-producing region, and

has facilities for handling the article rapidly not to be had at New Orleans, and every hour in dealing with the perishable stuff is of value.

Ten years ago, when I first presented this subject to the attention of my profession, the relation of Galveston and Houston in Texas was pointed to as an exception to my conclusion. It was said "Galveston has grown up as the commercial port of Texas; it is the only Texan port having a tolerably good harbor, but ocean-going vessels can be taken on the Buffalo Bayou nearly up to Houston, and with small expenditure of money a port could have been built up at some interior point on Galveston Bay. Galveston is built on a sand bar, practically 50 miles from any agricultural country, directly on the Gulf, and while the wharves on the inside are in a well-protected harbor, the island on which it is built is exposed to the violent action of the Gulf waves. The City of Houston at the head of Buffalo Bayou is fifty miles nearer the agricultural portions of the State; the railroads centre at Houston, and a single line connects Houston with Galveston; still Galveston is the commercial metropolis of Texas; it has become so because its wharves could be reached with less difficulty than those of Houston or even of Harrisburg, at the mouth of Buffalo Bayou." This was the argument adverse to my position. The answer I made at the time was, that "what can be done by a small outlay of money cannot as yet be fairly considered, for Texas is still a new country and must accommodate itself for the present with the existing facilities for its very limited amount of shipping. Glasgow is an example of what an outlay of money in the way of improving a channel will accomplish, and perhaps Houston may one day be another; but as yet no money has been expended."

Now, if I could have looked forward ten years, or if I had made a careful study of all the facts at the time, I should have seen that this very case illustrates the tendency of commerce to get as close to the producer as possible for its port. Houston has become, like Glasgow, an example of what an outlay of money in the way of improving a channel will accomplish. $193,000 have been so expended by the United States Government in deepening the channel of the Buffalo Bayou, so that if 13 feet can be taken in over the bar to Galveston the same depth may now be carried on up to Houston; and now Galveston, while a commercial port, has taken a secondary position in the commerce of Texas, and is not the port of that region to which Houston is related.

Galveston has commercial importance, but its growth is com-

mensurate with the growth of the coast districts, which has not been comparable to the growth of the interior. Houston, on the contrary, has grown with the development of the interior of the whole State of Texas, the great producing region. It happens, therefore, that Galveston is moving up to Houston, as shown by the statistics of population. Galveston has been a well frequented harbor ever since 1818, when it was the prey of the buccaneers; and the Pirate Lafitte found there a convenient harbor of refuge. After the Civil War, Texas received an important impulse in settlement, and in 1870 Galveston contained a population of 14,000, while that of Houston was but 9,000. But the State grew and the Houston man was closer to the interior than the man at Galveston, though it cost him a good deal to receive his goods. Hence in 1880, its population was 19,000 against 22,000 in Galveston. In 1890, improvements had progressed on the river so as to assure improvement for Houston trade, and its population had reached 28,000 against 29,000 in Galveston, and to-day Houston has a larger population than its rival, if it may properly be so styled, by 5,000. It may be claimed that this result is due to the railroads, which have made Houston a great centre, which is undoubtedly true, but would have had no existence in fact if the natural position of the town had not marked it to capital as the proper commercial centre of exchange instead of Galveston. The railroads would have gone to Galveston, but they have instinctive recognition that Houston and not Galveston is the distributing point for the merchant from the outside, who wishes to secure the trade of the interior of Texas. The natural result is that the wholesale trade of Galveston is moving thence to Houston, which, now greater in population and with greater movement in money, as exhibited in its bank clearances, will show in the next census that it has outstripped the old town in those features of wealth and prosperity that make a commercial centre.

But now another reflection arises touching the future of Galveston, of which the decadence may yet be arrested. The United States Government is spending $6,000,000 in the construction of jetties at the mouth of Galveston Bay for the purpose of admitting our largest warships to a harbor on that part of the Gulf coast. That port will then be accessible to vessels drawing 30 feet of water. This depth will admit the largest steamships that float, while as yet only 13 feet can be taken up to Houston.

If, then, an extensive coast system arises to support the trade of Galveston, the town will become something more than a mere port or commercial centre for the planters of the interior. It will

be a market, in the category of New York and San Francisco and Liverpool; not certainly in degree, but simply in nature. In that event it will become the point of attraction for Mexican trade and shipments in addition to those of its own limited coast. But Galveston must be *built* to such position by becoming the market of an important coast system which does not yet exist, for the Texas coast is still an unimportant producing territory. Otherwise, it will become and remain only a convenient shipping point, without commercial importance.

But the future of Galveston is an exceedingly nice problem, requiring patient analysis of the data, which cannot be given in the time at our present disposal.

Leaving the Atlantic Coast, we find a rich field of investigation in the far Northwest. The relation to the commercial world of Astoria, on the Columbia River, is an interesting instance of the conflict of capital with law in the attempt to regulate commerce.

Founded by one of the wealthiest, shrewdest, most enterprising and far-seeing citizens of this country, it became as it was intended by him to become, the dépot of the fur trade of the Northwest. When the fur trade failed and simply a home market existed for the salmon of the Columbia River, the men who had staked their fortunes or their hopes on that important point beheld with new satisfaction the settlement of great Willamette Valley above them. It was a natural expectation, that Astoria should become the commercial port of all that region. It was an established town; it possessed a harbor six miles wide, safely protected from the ocean, which was close at hand. It has grown continuously and is still growing; but this town, so convenient of access from the ocean, has seen the port of Portland come into being a hundred miles farther up the river and grow to a city of 80,000, while Astoria has never yet sheltered 8,000 souls.

The Northwest has been a prolific field for the exhibition of the speculative spirit of the men who have received vast areas of public lands from the national treasure and, backed by the national credit, have built the great trans-continental railroad systems. The Northern Pacific Railroad Company has been especially ambitious to own the earth and all its outlets. Twenty-five years ago, capitalists interested in developing the promising points along the route of the thoroughfare, determined that the Columbia River terminus of the line must be the commercial metropolis of the Northwest, the port of that great river system. So they located a town at a point sixty miles above Astoria and forty miles below Portland.

Such a magnificent location was to wipe out both former pretensions, and the town of Kalama was born, where railroad and stream and speculators had their union.

Maps were prepared, hotels and churches erected, elevators, warehouses and great docks projected; and the line of the Northern Pacific Railroad was built thence to Puget Sound.

By virtue of its future outlook, Kalama became a county seat. Corner lots in the heart of that famous townplat sold for $3,000 each; water lots were laid out along the river bank and sold for the sum of $3,000 per 100 feet of frontage.

Kalama still exists, but only in name; and the investors in its prospects have added the suffix "ty." The Columbia River still flows by its site as broad and deep as when Jay Cooke made note of its promise; but the once well-filled churches are abandoned for want of congregations; a corner of the grand hotel serves the purpose of court-house and jail; the splendid water lots still remain under the shadow of primeval trees, the only improvement they have experienced being in a reduction of annual tax from $28 to 15c. And yet this bubble was the scheme of men eminent for wisdom. It was inspired by reputable engineers and accepted by intelligent capitalists. Nor can there be any doubt of the uprightness of intention when we consider the high character of the men who gave the project their approval and practical endorsement.

Kalama is but one of several similar experiments that have sprung from the fruitful womb of Northwestern enterprise. When the Oregonian Railway and Navigation Company became the great power of the Columbia River Valley, it attempted a similar scheme; one in which many railroad companies have embarked and failed. Selecting St. Helens, a good place for a harbor and apparently for a town, when it was considered that all the transportation of the great river was in the hands of the monopoly, and several miles nearer the ocean than Portland, it built docks and warehouses and waited for the rush of capital from Portland to its sheltering arms. But the man who had goods to sell was too wise to leave his customers simply to get nearer the ship that brought his goods; and he said to the company if you can't come to Portland some other ship will; the result was the ship had to go to Portland, and St. Helens was abandoned.

The Northern Pacific Railroad Company has made another attempt to build up a commercial metropolis of the Northwest at Tacoma on Puget Sound. The position is well selected for doing the business of a limited district. It can never become a town of

commercial importance. It is at the head of the Sound and thus would seem to be near the heart of the producing region. It happens, however, that the "producing region" does not lie in that direction. There is a limited area of good country that comes naturally down the Puyallup Valley and Tacoma is at the mouth of that valley. We may understand how trifling is the area of production when we know that the Puyallup drainage passes off in a stream navigable only for canoes; that all the trade of Tacoma must come down the line of a single railroad. It was intended to be the terminus of the Northern Pacific Railroad, of which it has been the constant pet. Fine hotels, street railroads and all the modern conveniences of a great capital exist except the business, which is largely in real estate and gives a stock-exchange character to the town.

Some years ago there were ten banks in Tacoma, which sounds large; but their aggregate capital was a trifle more than a million and a half; since recent failures there are but two banks left. Steamships sail from the railroad wharves of Tacoma to China and Japan, just as four steamship lines sail from the wharves of Fernandina and with as little advantage to the port as a commercial centre. The booming advertisements of Tacoma claim annual foreign imports to the amount of $10,000,000; "mostly," say their authorities, "from China and Japan." That 36,000 people drink $10,000,000 worth of tea per year seems extraordinary even for Tacoma. The truth is that Tacoma has no particle of interest in those cargoes. They are shipped across the continent to Chicago and New York as rapidly as they can be loaded and got away. The same advertisements tell us of manufactures to the annual amount of $9,000,000. This is a better claim, but does not justify the great expectations of phenomenal prosperity, it being part of a system by which a land company is to work off its investment.

The Northern Pacific Railroad Company has built car shops in Tacoma that cost $1,500,000 and the results are given out as the manufactures of Tacoma. There are some saw-mills on the lower edge of the town. They were there years ago, before any railroad was thought of in that region and from six to ten large vessels are always at their wharves loading lumber. These mills and this lumber are owned in San Francisco; not even a pound of sugar or coffee or a loaf of bread is bought for these works in Tacoma. The workmen board in the company's houses, eat the company's food and drink the company's grog. The annual results of the mills are credited to the "City of Destiny" as 130,000,000

shingles and 17,000,000 feet of lumber, with which Tacoma has as little to do as with the creation of the world, save that some use is made of the banks for convenience in paying off men.

No important wholesale trade belongs to Tacoma. There is not in all the town a wholesale drygoods or grocery store. Much of the land once laid out in city lots has reverted to acre property. The street railroad and electric-light business are in the hands of receivers. Its present condition illustrates the impotency of capital's brute force when exerted against the natural laws of commerce. So far, Tacoma has failed to attain a position as the port of the little Puyallup Valley and the limited territory west of the Cascade Range. It has become a simple way station on an important railroad line, since the Northern Pacific Railroad Company has been forced by the demands of business to extend that line to Portland and Seattle. But by the nursing of the railroad company, Tacoma has succeeded in attaining position as a manufacturing town of subordinate importance, which is the legitimate province of capital.

Seattle, on the Sound at the mouth of an extensive river system, the centre of traffic in those valleys, that loads and discharges forty steamers a day, was left aside by the Northern Pacific Railroad Company. It was not the right field for a grand land speculation, being already an established town. It was going to be an easy matter for a powerful railroad company to force the traffic of those valleys, that came to Seattle to buy supplies, from their old channel into the promising property of Tacoma. The merchants of Seattle knew better. They failed to take alarm and held their ground to the surprise and consternation of the speculators. It is easier for one trader to take his goods to a community of a thousand customers than it is for a thousand customers to go a long way from home to buy goods. And so, in spite of the existence of a railroad and all its power, the Seattle man was close to the producer and he saw that his customers had their goods at as cheap a rate as anybody in Tacoma, for he had the Sound and steamers to many points on the coast. Without a railroad Seattle prospered and without booming. It forced the construction of proper Eastern connections and has become indeed a great railroad centre, being the terminus of four transcontinental lines. Seattle is an interesting instance of New England shrewdness.

It will be interesting, now, to look along the northern border of our country and observe the growth of towns on the St. Lawrence River and the Great Lakes.

There was a time when Quebec, the capital of Lower Canada,

was the commercial metropolis of those provinces, but Montreal, 220 miles farther up stream, took its place; and from 1850, when their population was about equal, Quebec has grown from 40,000 to 70,000, while Montreal in the same time has acquired a population of 220,000. It is nearer the centre of production, closer to the heart of the country. Following the same line of experience, Toronto, 333 miles farther inland than Montreal, had in 1871 a population of 56,000 and to-day has nearly 200,000, having somewhat more than tripled, while Montreal has rather more than doubled.

The opening of the Erie Canal in 1825 had a wonderful influence on the growth and future power of two towns. Up to that date, New York had been second to Philadelphia in commercial importance and population; but once the construction of the canal became an assured fact, New York, being brought into closer relation to the producing regions of the country, and cheap communication being established, the great West, as we then knew it, lay at her feet. But also, the little village of Buffalo became an outside ward of the City of New York. Up to 1825, its population had not reached 3,000 and in 1830 it had tripled; and to-day it amounts to 300,000.

Cleveland, farther up the lake, is growing even faster than Buffalo. You would suppose that produce making for the coast would rather go to Buffalo as being nearer the sea and in closer connection with the metropolis of the coast. Now Cleveland had in 1860 about the same population that Buffalo had in '50, but in 1890 Cleveland had a population of 262,000 as against the 254,000 of Buffalo.

A lesson is taught in this connection by the rapid growth of Detroit, 18 miles from Lake Erie, up the Detroit River, and 7 miles from Lake St. Clair, with a population of 250,000; not a harbor on the lake, but crowded into that narrow strait, that the importer may get as close as possible to the promising Michigan peninsula.

Thus, while Detroit supplies Michigan, and Cleveland grasps the wealth of northern Ohio, Toledo has seen the opportunity presented by the limited region lying between them and establishing itself eight miles from the lake, up the Maumee River, is already a great city and doing a service to commerce, the opportunity for which it has snatched from Detroit and Cleveland, because nearer than they to the producing territory.

We approach now the wonder of the century. Chicago is in-

creasing in population at a rate nearly double that of the combined cities of New York and Brooklyn. In three great products, grain, lumber and live stock, it leads the world. Lying at the foot of Lake Michigan, it appears in a *cul-de-sac.* How does it come that a great centre of exchange has grown up at Chicago? It seems more rational for it to have come to Detroit or Toledo, 140 or 160 miles farther east. It is 800 miles from the ocean across country and 2,000 miles away by the only water route open to it. Is it great by having been made the focus of so many railroad lines? On the contrary, it is the centre of so many railroads because its position marked it for greatness. It is a great railroad centre because it lies so close to the heart of an exceedingly productive country. Chicago does not exist by reason of the railroads, but the railroads do exist because of Chicago.

Proceeding still westward, we find Duluth-Superior at the upper end of Lake Superior. We see at once it occupies a promising position, not because it has been made the terminus of railroad lines, but because it is favorably situated geographically, to be the *entrepôt* of an important producing section. Observing, however, that Duluth has a fine future only on the west and south, and that for a very limited distance, we discover at once that it is not to become another Chicago, nor even the peer of Detroit or Cleveland. The idea has been indulged that Duluth with its 30,000 souls may absorb St. Paul and Minneapolis with an aggregate population of 350,000, because it is on the lake, while the others are inland towns. The man who invests his money with this absurd expectation deserves to lose it to the fellow who will make a better use of it. No merchant, who is now doing business at St. Paul or Minneapolis, will move 160 miles farther from his 350,000 customers, to get that much closer to the man in New York or Liverpool who is competing with others for possession of his crops and to sell him his stock of supplies.

The condition of things we have been considering is not confined to the American continent. It is a condition as long as trade and as broad as the world of commerce.

If men had looked no further than that little ancient island nearest to us on the European coast they would have discovered in Irish ports an illustration of the requirements of commerce so plain, so emphatically pronounced, the lesson seems extended towards us on the outstretched arm of Providence. The ports are simply the commercial ports of the regions in which they are found; that is to say, they do not control nor are they controlled by any extensive

coast systems. They are each the port of an interior district, drained by the rivers on which they stand. So we find Galway, Dublin, Dundalk, Wexford, Belfast, Sligo and Cork, the farthest points inland on the bays of those names to which a ship can go, while Limerick is at the head of ship navigation on the Shannon, and Londonderry is above Lough Foyle and several miles up the Foyle River.

While Liverpool, the port and mart of an immense coast system, is but three miles up the Mersey, but not too far removed from its customers, London, peculiarly the port of England's interior territory, is at the head of navigation on the Thames.

Glasgow, on the Clyde, owes its wonderful prosperity to its position at the head of navigation—an artificial harbor, made practicable by its propinquity to the coal and iron of the country. When I was a boy, a man of my present stature could have waded the Clyde at Glasgow, without wetting his shoulders, and to-day no ship engaged in general commerce fears to charter for that port. Seventy years ago, everything going up the Clyde made for Greenock, now scarcely more than an outside ward of Glasgow.

Time was, when men thought to build a port on the Elbe, below Hamburg, and Altona was started as a rival to the great capital. It was nearer the ocean than Hamburg, and therefore easier to reach; it had the backing of a patriotic, ambitious government and for a time did seem to threaten the existence of the ancient port. But observe the perverse temper of commerce. Ships pass by the convenient port of Altona to enter the docks of Hamburg, and Altona has become only the suburban home of the successful retired Hamburg merchant.

A sufficient statement of fact has now been presented to justify a consideration of the premises that immediately determine the location of a commercial port or great mercantile centre.

The producer of a given region, whether artisan or farmer, will deliver his wares at such point as will entail on him the least cost of transportation; he will go to the port by the shortest road, as measured by commercial distance, in which not alone the geographical mile is the unit, but the mile multiplied by the cost of movement.

Again, there is never competition to sell among producers. Hence they are outside the struggles of trade; they are not found crowding forward toward the purchaser, the agent of the consumer, the exporting merchant. Indeed, the chances are that crops will be sold in the first instance on the soil that bore them.

If producers were competitors, commercial towns would be pushed toward the sea to catch the first chance at the customer from abroad; and farmers, turned speculating capitalists, would become the originators and managers of railroad lines. But, on the contrary, the agents of the consumers, the merchants who send the crops abroad and import the goods they barter in exchange, are the men who jostle each other in the marts, who push into the interior of a country, to get as near to the field of produce as they can reach.

Thus it is that a great commercial city cannot be reared near the coast at any site which a large ship can pass, and sail nearer the producing region to load or even to unload. A new port may be built farther inland than a port already existing, as in the case of Glasgow, provided that in so doing it gets nearer the producing centre, which is the object of the old port; but a new port cannot be successfully removed from such a centre and placed nearer the ocean; it cannot thus injure the original port. It will, possibly, become a convenience, like the area door of a man's residence. It cannot reach a higher dignity.

From all these elements, I deduce the proposition, which I venture to call a law in political philosophy, that *the commercial port of a region will be as close to the producer as it is possible to go, and obtain reasonably good facilities for the class of transportation demanded by the produce of the country.*

I say this is the law; I believe it to be the inexorable, immutable law, without exception in the world's economy.

In accordance with this law, Montevideo, on the outer coast of Uruguay, has a population of 175,000, while Buenos Aires, a hundred and thirty miles up the river, contains 600,000 inhabitants. Guayaquil, in the edge of a sickly swamp of Ecuador, might have been healthily placed forty miles down stream, at a point famed for its salubrity, imposing forty miles less of river navigation, with equally good facilities of anchorage and discharging cargo; and better potable water for a population. The expense of transporting the products of the country, by the agency of native boatmen on balsas or in canoes, to a situation where whites can live without fear of malignant fevers would be trifling indeed; but such a course would separate the speculator from his game, the cacao, hides and woods of the country, and the merchant from his customers, the producers of those articles, by all that distance of forty miles, letting some braver adventurer cut it short and pitch his camp at his

customer's door, though the Angel of Death stood guard there, with the two-edged sword of yellow fever and small-pox.

I have said that "a great commercial city cannot be reared near the coast at any site which a large ship can pass and sail nearer the centre of production to load or even unload." At first view the statement seems inapplicable to New York, because the Hudson is navigable for large ships a hundred miles or more above that city; but this isolated fact does not contradict the law. If New York were simply the commercial port of the Hudson River valley, the objection to the law as stated would hold good. But the truth is it was not the port of that valley until the importance of its relation to a grander producing territory forced tribute from or absorbed every community within its reach. Albany, settled in 1614, was the all-sufficient port of the upper Hudson until increased population gave the region a foreign commerce, and then Hudson, at the head of ship navigation, 116 miles above Manhattan Island, became the port of the valley, maintaining an amount of shipping superior to that of our great metropolis, and carrying on trade with the West Indies and Europe, in addition to its whaling and fishery enterprise. But the valley is restricted in breadth; there was no great extent of country to seek its waters; going up the Hudson was not going inland, in the sense of approaching the heart of any great producing region.

The birth of New York in 1623 was an existence quite independent of the river valley. It was the centre of an immense coast system, including Manhattan, Long and Staten islands; New Jersey, directly west, and the shores of Connecticut. The valleys of the Passaic and Hackensack and all the country back of the precipitous west bank of the North River found the Manhattan port more accessible than any other point.

Meanwhile, Elizabeth and Newark became the centres of promising agricultural and manufacturing districts, and naturally brought their commercial exchange to New York as the nearest market. But, as late as 1820, the population of Philadelphia, so much nearer the heart of production, was greater than that of New York and remained so, until work on the Erie Canal had progressed three years and made the canal a certainty. The belief in this certainty gave impetus to values immediately along the line and in the valley of the Hudson. When the canal was opened, New York was moved just so much closer to the interior, and the merchant of the city sent forward his agents to buy up grain and ship to his port, so that if Liverpool, London and Hamburg had been the principal

grain markets of the world, New York now entered into the same category, and its population was doubled in the decade that saw the canal finished.

New York, therefore, is not simply the commercial port of the Hudson River valley, but of half the continent, and owes its position, not to its accessibility from the ocean, but to its central location with relation to the producing region directly west and southwest, as well as northwest.

It has been urged that "on the Pacific Coast there is the case of San Francisco. That city lies close to the ocean. Apparently it is removed from all producing country and owes its commercial position to its accessibility from the ocean. Before the introduction of hydraulic mining, good-sized vessels could go up to Sacramento and the largest class of vessels still take their cargoes up to Benicia and load there for return, with the products of the San Joaquin valley. If we look no farther, we shall say that on the basis of what has been here claimed to be law, Sacramento, which is in the heart of the great valley of California, and which is as much nearer to the mining districts as it is to the agricultural region, ought to be the commercial metropolis of California, and the Sacramento River should have been improved instead of being allowed to deteriorate. If, however, the difficulties of river navigation seem too great, then a great city ought to have grown up at Benicia, or at some point above that site. The facts are precisely the reverse. San Francisco, nearer the ocean than any point named and farther from the centre of production, has become a great commercial metropolis in violation of what has been proclaimed as a natural law." This was the argument. This view is, however, extremely superficial.

On close analysis of the case we find San Francisco occupying a situation much like that of New York, in being the centre of an extensive coast system. It forms no exception to the general law, nor even a modification of its absolute truth.

Sacramento is the port of the upper river as Benicia is of the lower, receiving the products of the San Joaquin Valley. Tributary to them is a population of 250,000 inhabitants.

But San Francisco is the port of a distinct region. It is not only the convenient harbor of all the lower bay with a population of 250,000, outside its own municipal limits, but is the only first-class harbor of all the coast between Monterey and the Columbia River, a region with an additional population of 400,000 souls.

As the little ports along the coast bring their tribute to a mart

in light sloops and schooners, they must find a harbor as near at hand as possible, precisely as the inland producer finds his port. This they have found in the Bay of San Francisco, as close as possible to the ocean and therefore for them as close as possible to the producing territory, and therefore as close as possible to the north and south ocean coast. And so San Francisco is located where it is, not to be accessible to the ocean, to Yokohama and Hong Kong, nor yet to the Sacramento Valley, which has its own port, but to the numberless little inlets along the Pacific shores north and south of there, which ship their products in small vessels to the nearest great harbor. If San Francisco did not exist a great port for the reason thus stated, it would not exist at all.

Like New York, being the centre of the varied products from a vast area, San Francisco has become a convenient manufacturing point and the port of a population of about a million souls, not including the Sacramento and San Joaquin valleys. On this account it has become a commercial mart as well as port, and has thereby absorbed the capital of all the interior river ports. Without New York and San Francisco, the valleys above them would ship directly to Liverpool or some other great market of the world. That has become unnecessary; they find the market at their doors, and ship to New York and San Francisco from their own upstream local ports.

It has been said in the discussion of this problem and in opposition to my solution, "that San Francisco is separated from the whole agricultural portion of California." So far is this from being the truth, that if we consider the Sacramento and San Joaquin valleys fairly tributary to Benicia, while the shores below Benicia and the sparsely settled coast are tributaries of San Francisco, the value of farms in the former district according to the last census is less than $180,000,000 as against $170,000,000 in what is called the "inferior" farming country, while in manufactures the valleys produce $24,000,000 a year to be offset by $172,000,000 produced by the manufactures of San Francisco Bay and coast.

It seems safe, therefore, to say that San Francisco has a *raison d'être* quite in accordance with the law as I have stated it.

Liverpool seems to be another exception to this law. Liverpool is one of the great markets of the world. It owes no considerable part of its mercantile importance to the trade of the Mersey. It is also a great coast centre, reaching out to the Irish as well as the English coast. It is especially the port of Ireland, one-third of its population is Irish, and but for the immense expenditure in docks

would be as independent of the caprices of capital for prosperity as any other city.

It has been said that the Manchester Canal is a failure because it should have removed the port to Manchester from Liverpool. This is supposing that the producing region of which Manchester is the centre is greater either in area or importance than that tributary to Liverpool, which is not the case. Manchester has been brought nearer to Liverpool by the canal, as Buffalo to New York by similar means, and one exceedingly important result has been that Manchester merchants are receiving their goods from abroad and are transacting all their business with Liverpool at a vast saving over prices pre-existing; because, if the canal does not execute the work, it is there as a standing menace to keep the railroads in order. It has had this effect in a remarkable degree, just as the Erie Canal has influenced the freight rates of the New York Central Railroad. This being the case, it matters little whether the canal does the carrying or not; it answers the end for which it was constructed, in giving the Manchester man all the relief for which he prayed.

Another extraordinary result is that a solid city is concentrating in the thirty-two miles of country between Liverpool and Manchester.

The map of South America shows a remarkable number of ports close to the ocean, when apparently they might better, in accordance with the law here presented, have been planted, geographically speaking, further inland; the fact seems to offer encouragement to the projects I have ventured to condemn.

Pará and Rio are prominent ports of the class in mind. It is true that Pará is 80 miles from the ocean. It might have been 600 miles farther up stream and have equally good accommodation for ships that seek its anchorage. It was located where it is, for several reasons. At a point 80 miles up stream, it is as far as it is possible to go and find a salubrious location, the soil at that spot being sandy and especially free from miasmatic poison. But this fact would not alone have weighed in its location, for men brave death in battle for the wages of the soldier. It was carried up there instead of locating it nearer the sea or farther up stream, for the purpose of getting as close as possible to the rich productive centre of the Province of Pará, which is unequalled in the wealth of its vegetable production. The Province of Pará is fairly well settled for Brazil. But the upper valley of the Amazon is still a wilderness, although along its course are many towns, the centres

of exchange for limited districts. Pará is at the mouth, also, of the Valley of the Guamá. Thence it receives the trade of a rich district and is the market of the rubber brought from the upper valleys. I have no idea that any other town, the peer of Pará, will ever rise to rival it in any part of the vast valleys of the Amazonas, because no town will have its site near so rich a centre of production as the Province of Pará and the Valley of the Guamá. It will therefore become a great metropolitan mart as well as port.

Rio de Janeiro has been mentioned as a commercial metropolis near the ocean. It is on a bay extending inland about 18 miles from the sea. The city is on the west bank four miles from the entrance. Apparently it might have been placed much nearer the interior. Now the interesting fact is that the original town was on the other side of the bay, close to the ocean at Nictheroy, and was moved to where it now stands to be more accessible to the interior. It is on the only flat in that precipitous shore, from which an accessible pass leads through the mountains to the interior, the Province of Minas Geraes, the most populous and best cultivated province of Brazil. At the same time it is accessible to the coast province of Rio de Janeiro, with a population of 1,000,000 souls. Rio has thus become one of the great markets of the world. Its exports equal in value those of all the rest of Brazil combined. It therefore occupies, in relation to Brazil, much the same position that New York holds with relation to the commerce of North America, having like New York an immense coast trade.

Observing the coast of the Guianas, we find nearly all their important ports near the ocean; accordingly we learn that their settlements are also along the coast. It is true that Paramaribo in Dutch Guiana is ten miles up the Surinam River, and Dutch Guiana is exceptional, in that its settlements have extended up from the coast on that stream. Georgetown, of British Guiana, is at the mouth of the Essequibo River on which there are many settlements; but they have not kept pace with the settlements on the more salubrious coast, and therefore Georgetown is put where it can best reach its more valuable class of customers.

Cayenne, at the mouth of the Oyac River, is a French penal settlement. Its location has no relation to trade, but it is nevertheless the port of French Guiana, placed where it can best be reached by the vessels that convey criminals from France.

I repeat that only the coast of the Guianas presents inducements o settlers, the interior being insalubrious.

It will be observed that Maracaibo, in Venezuela, is at the head

of the Gulf of Maracaibo. Apparently it should have been placed farther inland at the head of the lake, which is simply an extension of the gulf. The truth is that a bar at the mouth of the lake, where it enters the gulf, prevents the more desirable location, so that Maracaibo is really at the head of navigation. If the region prosper, so that in time it will repay commerce to remove the bar, then the port will undoubtedly go to the head of the lake.

Cartagena, in Colombia, is on the ocean coast like Galveston. Its history, like that of Galveston, indicates the progress of settlements in that part of the Republic. Two ports have been started to do that which Cartagena has failed to do, *i. e.*, furnish proper facilities for accommodating the new condition, by reaching the customers of the men who conduct the trade of the region. Santa Marta was started with the idea that easy access from the ocean was the principal requirement for a port, and being located under the influence of this blunder on the coast, attained to a population of barely 4,000 living on a trifling coast trade, while Barranquilla, fifteen miles up the Magdalena River, near the producing centre, has already a population of 21,000, being more than twice that of the original port, which has dwindled to 9,000 and is still decreasing.

Angostura, also known as La Ciudad de Bolívar, on the Orinoco, is 240 miles from the mouth of that river. Vessels of 300 tons go up there under sail against a strong current. Still it is by no means at the head of navigation. It would be as easy to go farther up as to go to Angostura. But at the distance now reached commerce is at the gate of the region it seeks. There it is the treasure is found in the customers of the best producing district yet settled, and there it remains to barter its goods for the produce of the country.

The South American continent is not yet peopled. It has scarcely begun the progress of the century, and the future is all before it. A great future it will surely be, when the northern half of the hemisphere is filled with its rapidly multiplying millions, and their influence has forced real liberty on the governments of those states now under control of a debased ecclesiastical system. At the present time many of the South American ports hold to the country just the relation held by the port of Boston, before the settlement of the interior brought other cities to the front, when Boston was the most important commercial city in North America.

The direction of trade routes, barely touched in discussing the relative positions of New York and Boston, is an important factor

in establishing and maintaining the commercial metropolis of a region. It was mentioned that Boston capital had tapped the country north of New York in the hope of drawing off the trade of the West to itself. The result of the Western railroad has not been what was expected of it. Troy and Albany are nearly at equal distances from New York and Boston, but the immense capital of the Eastern city failed to seize the products of the West. The enterprising Bostonian saw that a mountain intervened, and he pierced the obstacle, reducing the difficulties of transportation to their lowest terms. Still he has to contend against one radical truth, which he is either ignoring or striving to eliminate from existence by persistent employment of capital. This truth is that trade follows natural channels; that the staple products of the soil and all the coarse minerals will reach the coast by the route that permits the easiest movement with the least artificial aid, generally the lines of drainage of a country. The trade of a region will not cross a great valley even to reach a market of the first importance. It will either create centres of exchange in such valleys or, having reached them, follow down their course to a port. Thus, Western produce reaching the Hudson River will follow that stream to New York for exportation, as the produce of the immense Mississippi Valley goes to New Orleans and not to Mobile.

In the Northwest, the relation of Portland, on the Willamette, to Puget Sound closely resembles that existing between the ports of New York and Boston. Portland occupies the site of a great commercial centre for an immense region, the entire basin of the Columbia River, of which 160,000 square miles are within the limits of the United States. All the country west of the Rocky Mountains, tributary to the Northern Pacific Railroad and seeking an outlet on the western coast, will, on going that way, make the mouth of Snake River, on the Columbia, a common point of departure for Puget Sound as for Portland; from that point the trade will either descend the great valley or, proceeding along the line of railroad, cross the Cascade range and enter the Puget Sound district for a harbor.

The lineal distance in either case is about the same. The commercial distance is greatly in favor of Portland. In this case there is a descent of 300 feet in favor of west-bound traffic going to Portland. There is only this ascent in going east. On the other hand, there is a summit of 2,400 feet to be overcome by west-bound traffic and 2,700 for that east-bound, besides the sinuosities

of a severe mountain line and the income demanded by increased cost of constructing it with fairly practicable grades.

And yet intelligent men believe it possible to remove the commercial metropolis of the region from the spot on which nature located it and transfer it to Puget Sound, because they have planted capital there for such a purpose.

A distinguished advocate of this remarkable system of supplanting commercial centres and centres of exchange declares with some emphasis that "the commercial ports of the world were established before the existence of modern facilities for transportation; having become established and capital being located, they have maintained their positions as commercial centres, although we cannot say they would have been so located if the railroad systems of the country had first been built." The statement is an important one, because it is precisely the sort of reasoning that has led to a vast dissipation of capital. The truth is, and this statement is one proof of it, that the commercial ports of the country have grown up in accordance with natural law, when men were without artificial means to help them; they are therefore instinctive or intuitive locations. So true is this that one cannot state the case of a new commercial port, started by the influence of capital and railroads in rivalry or opposition to one of the old ports, that has been a success, that has not, indeed, been a pronounced failure, and there are many such attempts. It would be impossible to mention a commercial port the relation of which to its neighboring ports has been changed by the influence of railroads. Certainly, railroads have increased the commercial wealth and machinery, but they have not diverted, and I dare to say they never will divert, trade from the direction of its natural channels.

Every new commercial port undertaken by railroad capitalists has been a failure in reaching the fulfillment of its promises, and such enterprises must continue to be failures.

Ports will be established by trade and by trade alone. The railroads do not make the trade of the country; they are the offspring of its trade. Trade exists without railroads, but railroads cannot exist without trade.

## THE AMERICAN ASSOCIATION.

### Fiftieth Anniversary.

The American Association for the Advancement of Science celebrated the fiftieth anniversary of its organization by holding an unusually large and important meeting in Boston, the city of its birth. The first General Session was held on Monday, August 22, and the meetings were continued throughout the week.

In 1847, the parent association—the American Association of Geologists and Naturalists, which was organized in 1840 as the Association of American Geologists—held its annual meeting in Boston under the presidency of William B. Rogers. At this meeting it was decided to enlarge the scope of the Association by the adoption of a new constitution that should embrace all branches of science and admit all lovers of science. The present Association was, therefore, organized in Boston, although its first regular meeting was held in Philadelphia, in 1848, under the presidency of William C. Redfield. For two years the meetings of the Association were held in the South in the winter and in the North in the summer; and as they were suspended for five years, during the period of the Civil War, the fiftieth anniversary thus occurred at the forty-seventh meeting.

At the first General Session on Monday, the retiring President, Professor Wolcott Gibbs, of Harvard University, presided and called upon the Rt. Rev. William Lawrence, Bishop of the Diocese of Massachusetts, to offer the opening prayer. Addresses of welcome were made by His Excellency Roger Wolcott, Governor of Massachusetts; by His Honor Josiah Quincy, Mayor of Boston; and by Professor James M. Crafts, President of the Massachusetts Institute of Technology. Professor Wolcott Gibbs then introduced Professor F. W. Putnam of Harvard University, the President of the Boston meeting, as one who had served the Association for twenty-five years as Permanent Secretary, and who had achieved high distinction in his own special branch of science—American archæology and ethnology. Professor Putnam received a prolonged and hearty greeting from the members of the Association, among whom he has made hosts of warm friends during his long service as their executive officer. He accepted the presidency of the Association as the highest honor that could be bestowed upon him, and was especially gratified at receiving it from a founder of the Association. After replying

to the addresses of welcome President Putnam gave a brief summary of his thirty-three years' connection with the Association, and called upon all young scientists to follow his example and become members that they might receive the benefit of contact with the great minds in science. He referred to the extreme specialization in science which he considers the main cause of the decrease in the membership of the Association during the past few years, and he urged all specialists and members of special societies to join the parent society, where they could do such good work in the general advancement of science by throwing light upon the problems coming under their special research. At the close of his remarks President Putnam called upon M. Désiré Charnay, the representative of the French Government to the Jubilee Meeting of the Association. M. Charnay spoke briefly in French. President Putnam then read a message from the Russian Geological Committee of St. Petersburg extending to the American Association respectful congratulations and good wishes.

In the afternoon eight vice-presidents delivered addresses before the respective sections. Vice-President Cooley, Chairman of Section D, had been called to active service in the Navy, and sent word from Santiago, Cuba, regretting his inability to be present at the meeting.

In Section E (Geology and Geography), Professor Herman L. Fairchild, of the University of Rochester, delivered his vice-presidential address on the subject, "Glacial Geology in America." He considered this fiftieth anniversary of the Association an appropriate time for a general review of the progress of the glacial theory in America. "The life of this Association with that of its predecessor covers precisely the period since the glacial theory was introduced to American geologists. . . . The reports of the early State geological surveys, the transactions of learned societies and the volumes of Silliman's Journal, to about 1850, contain frequent reference to 'diluvial drift,' 'diluvial scratches,' 'tremendous currents of water,' and terms of similar import. The first suggestion of ice as a contributory agent in the genesis of the drift, in the form of icebergs or ice floes, was made by Peter Dobson of Connecticut in a letter to Silliman, dated November 21, 1825. The first American geologist to give a favorable reception to the glacial theory of Agassiz, as far as printed reports show, was Edward Hitchcock, in his presidential address before the Association of American Geologists and Naturalists at their second annual meeting, held in Philadelphia, April, 1841. Unfortunately for truth and for American

geology the circumstances and scientific forces of that time did not allow him to stand upon the advanced ground he had taken," and for ten years afterward no American geologist ventured openly to adopt and proclaim the theory of Agassiz. The force of theological opinion was against the glacial theory. "The hypothesis invoking water as the drift agency might be harmonized with the belief in the Noachian deluge, but the Bible gave no countenance to an ice deluge." In 1846 Louis Agassiz arrived in America; and in 1848, at the first meeting of this Association in Philadelphia, "he described the glacial phenomena about Lake Superior, showing the identity of the phenomena in America with those in Europe." The reception of the paper was not encouraging, and Agassiz did not present another paper before the Association until 1870. But from about 1850 the glacial theory began to gain ground, the younger generation of geologists being less prejudiced against the new theory. The periods in the history of drift-study in America are as follows:

"Undisputed reign of diluvial hypothesis—to 1841.
Discussion of the glacial hypothesis—1841 to 1848.
Gradual adoption of the glacial theory—1849 to 1866.
Development of glacial geology—1867 to date."

The remaining portions of the address were devoted to a study of the "Ice Body; The Glacial Period; Interpretation of Special Phenomena,—drumlins, moraines, eskers, kames, kettles, valley drift and terraces, loess, lake basins and pre-glacial drainage, glacial lakes;" and "Existing Glaciers." In closing, Professor Fairchild suggested that the glacial geologists should give up the use of the word "theory," since "it is no longer a theory but an established fact."

On Monday evening the retiring President, Wolcott Gibbs, delivered his presidential address before the Association on the subject, "Some Points in Theoretical Chemistry."

Following the plan of the Boston Meeting of 1880, the Association accepted an invitation from the Essex Institute to spend one day in Salem, and another from the Corporation of Harvard College to spend one day in Cambridge. On Wednesday, "Salem Day," no sessions of the sections were held. The members were taken by steamboat or train to Salem Willows, where they were received and welcomed by the officers of the Essex Institute and the Mayor of the city. A little after noon an old-fashioned New England fish dinner was served, and in the afternoon the members were con-

ducted by guides to the several points of interest in this old historic city. The largest party visited the Essex Institute and the Peabody Academy of Science, while others were shown the records and relics of Salem witchcraft, the haunts of Hawthorne—including the House of Seven Gables—the ancient architecture, old cemeteries and educational institutions. The party returned to Boston late in the afternoon and in the evening listened to lectures on the Metropolitan Water Supply, by Hon. Henry H. Sprague, chairman of the Metropolitan Board; and on The Transit in Boston, by Hon. George G. Crocker, chairman of the Transit Commission.

On Friday, "Cambridge Day," only a few of the sections held sessions in Cambridge. The various departments of Harvard were open for inspection, and officers of the various scientific institutions were present to give information. Lunch and tea were furnished by Harvard College in Memorial Hall. In the afternoon, Section H held its largest session in the lecture room of the Peabody Museum. On this occasion Mr. Frank La Flesche of the Indian Bureau, read a most important and interesting paper on "Ritual of the Sacred Pole of the Omahas." Mr. La Flesche presented a vivid picture of his own childhood as an Indian boy, and of his participation in the ceremonies connected with the Sacred Pole of the Omahas. He described his interviews in after years with the aged keeper of the Sacred Pole, and told how he finally persuaded the keeper to allow it to be transferred to the Peabody Museum, where he promised it should be kept for all time as a sacred relic of the tribe. The songs connected with the ritual of the Pole were in part sung by Mr. La Flesche and partly given on the graphophone from records which he had secured from the old Indian keeper of the Pole during his visit to the tribe this past summer.

In the evening, Dr. Charles W. Eliot, President of Harvard University, delivered an address in Sanders Theatre to the members of the Association on the subject, "The Destructive and Constructive Energies of Our Government." By request of the Council, this address will appear in full in the Volume of Proceedings of the Boston Meeting.

During the week of the meeting, 443 papers were read in the several sections, and many were of unusual importance. It will be possible, within the limits of this brief report, to notice but a few of those bearing upon some branch of geographic science, while others of equal importance will necessarily be omitted.

In Section H, Miss Alice C. Fletcher gave an illustrated paper on the "Significance of the Garment, a study of the Omaha Tribe."

This paper, like all Miss Fletcher's contributions to ethnology, gave the results of personal observation and study during her long residence among the Indians. The lantern pictures showed the different modes of adjusting the blanket as indicative of different moods and actions. The following summary will give an idea of the substance of the paper: "We have found the garment to have been an invention by which man's self-consciousness could be emphasized. Its practical uses were subservient to this primary purpose. We have noted that man's self-consciousness was born of attrition with his fellows, that his use of garments indicated not only the birth, but the development, of his conscious personality, that they expressed his relations to the unseen world, that they came to characterize his experience and exploits, to mark his place and obligations in society, and finally his freedom in personal expression."

Dr. Wolfred Nelson, a Fellow of the Royal Geographical Society, read a paper in Section I on "Cuba: its Past, Present and Future." Dr. Nelson has lived for some years in Cuba, and he spoke from personal observation. After presenting a geographical description of the island, he said that about one-half of the area remains almost a virgin forest. He referred to the native woods, including mahogany, hard cedar, ceiba and ebony, and dwelt upon the mines and minerals of the island, especially in the province of Santiago de Cuba. He spoke of the abundant crops of fruits and vegetables, and described the beauties and the dangers of the climate. In conclusion, he said, "Knowing that island as I do, I fear that an independent Cuba will be an impossibility. As an American colony she will blossom and bring forth her increase. Then, and then only, will the black plague of central and eastern Cuba cease to be a nightmare. It is a question of time. Cuba will be the brightest spot in the colonial possessions of the United States. Old conditions have passed away. This great and glorious republic must face her destiny."

An extremely interesting paper read in Section E was by Dr. Horace C. Hovey, of Newburyport, Mass., on the subject "The Region of the Causses in Southern France," illustrated with maps and stereopticon views. From his interest in the study of caves Dr. Hovey was led to join an expedition under the leadership of M. Edouard A. Martel. Les Causses is the name given to lofty table-lands in the Departments of Lot and Lozère, along the western declivity of the Cevennes Mountains, "causses" being from the Latin *calx*, meaning limestone. The Causses vary in height from 1,000 to 5,000 feet above the sea. The caverns form one of

the most remarkable features. There are several hundred, some inhabited and others used as sheepfolds. A few are quite new geologically and others are very old. The paths to them are along terraces or from the overhanging cliffs. They are almost exact counterparts of the cliff dwellings of our Southwest. From one of these caves 300 prehistoric skeletons have been taken. Another cave has nine vertical pits locally called "wells," which are from 40 to 130 feet in depth. The stalactite decoration of the caves is remarkably fine. This region has been almost wholly unknown, partly owing to the superstitious dread of the peasants; but now, under the stimulus of the Société de Spéléologie, it will soon become better known.

Professor G. Frederick Wright in Section E gave a paper on "The Age of Niagara Falls as indicated by the Erosion at the Mouth of the Gorge." The author referred to a remark of the late Dr. James Hall that "the outlet of the chasm below Niagara Falls is scarcely wider than elsewhere along its course." This he considered important evidence in support of the theory of a shorter duration of time since the glacial epoch than has generally been estimated. Professor Wright was greatly strengthened in this opinion by his investigations this summer, since he found that the disintegrating forces tending to enlarge the outlet and give it a V-shape are more rapid than has been supposed. He concludes that at the lowest estimate twelve thousand years only would be required for the enlargement of the upper part of the mouth of the gorge, a thousand feet on each side, which is largely in excess of the actual amount of enlargement. He believes the gorge cannot be much more than ten thousand years old.

Professor J. W. Spencer, of Washington, D. C., gave a paper on "Another Episode in the History of Niagara River," which was a sequel to that read before the Association four years ago upon the "Duration of Niagara Falls." The writer gave a revision of the intermediate episodes in the history, while the Falls were receding from Foster's Flats to the point of the railway bridges. He stated that after the descent of the river reached its maximum of 420 feet (by the retreat of the Ontario waters toward the north), the return to the present amount of 326 feet was interrupted by the subsequent rising of the level of the lake in the gorge to the height of 75 feet, thus reducing the descent of the river to 250 feet. This rising of the waters was occasioned by the lifting of the barrier at the outlet of Lake Ontario to an elevation 100 feet higher than the present one. By the subsequent dissection of this barrier, partly com-

posed of drift, the descent of Niagara has been increased to 326 feet.

A second paper by Professor Spencer was on the "Evidence of Recent great Elevation of New England." It contained a description of the valley terraces illustrated by actual sections, showing that the declivities of the valleys are not by even slopes, but by a succession of steps, the plains of which become terraces farther down the valley. These steps are regarded as gradation plains in the changes of the base-level of erosion, and many of the corresponding terraces are hundreds of feet above the floors of the valleys. From those features it is not inferred that the elevation need to have been from below sea-level, and consequently the gravels are not claimed to have necessarily been of marine origin.

Professor B. K. Emerson, of Amherst, Mass., read a paper on "An Outline Map of the Geology of Southern New England." The map includes Massachusetts, Connecticut and Rhode Island, and shows first, the line of Archæan out-cropping rocks, which extend along the axis of the Green Mountains from the Hoosac Tunnel to the Highlands on the Hudson, and second, the eastern Archæan granite area from Southboro to New London. The order of the successive formations, the distribution from the second area of feldspathic material toward the northeast, and the later eruptions, which furnished softened matter to blend with it, were noted; also the deposition of great beds of sandstone and shales, the folding of these and their compression into gneiss and marble, and the later processes by which the present topography was produced.

Professor Thomas Wilson, of the United States National Museum, contributed a paper to Section H on the subject, "Art in Prehistoric Times." The speaker propounded and illustrated the theory that art has been the germ of civilization, rather than one of its results. Its earliest manifestation is seen in the works of the very earliest man of which we have knowledge through his archæological remains, palæolithic man. Hundreds of his relics, in flint, bone and tusk, have been found, mostly in the caves of Southern France. Some of these show a purely decorative engraving, and in some cases the article itself is purely ornamental. In the neolithic age man's art was of a different character, and almost purely decorative, being marked and incised in pottery and bronze. As this art was evidently for the simple purpose of giving pleasure to the eye, the speaker considers that prehistoric man had in a degree the purely artistic sense.

Vice-President Fairchild presented to his section a paper on "Basins in Glacial Lake Deltas." He described a curious kettle-hole in a glacial lake delta in New York. This basin is situated in a delta which was formed by the deposition of drift and rock in a glacial lake. The delta now forms a plateau 125 feet above the village of Potter. The basin occupies about one-fourth of the area of the plateau and extends to the very base of the deposit. The only satisfactory explanation of its origin is that an isolated block of ice was left here by the receding ice front, the delta material was piled around it, and the subsequent melting of the ice block produced the cavity.

A second paper by Prof. G. Frederick Wright described "A recently discovered Cave of Celestite Crystals at Put-in-Bay, Ohio." These crystals are of a delicate blue color, hence called "celestite." They occur in many places in Europe; but the principal locality in America from which the museums have been supplied with specimens is Strontian Island, in the western end of Lake Erie. Just as this supply was becoming exhausted, a remarkable fissure was discovered last winter in Put-in-Bay Island, which is completely surrounded with very large crystals of this beautiful mineral. The fissure was penetrated in digging a well seventeen feet below the surface. It is large enough to permit the entrance of ten or twelve persons at a time. It is not an ordinary cavern, but is apparently the interior of an immense geode lined with crystals of this mineral.

In a paper entitled "Burial Customs of the Ancient Zapotecans of Southern Mexico," Mr. Marshall H. Saville, Secretary of Section of Anthropology, gave a brief account of his recent explorations under the auspices of the American Museum of Natural History. At Xoxo, five miles south of Oaxaca, he discovered a group of pyramids or "teocallis," which had evidently been used for sepulchres. To the west of the principal "teocalli" is an oval mound and on the other three sides are oblong rectangular pyramids. A most important discovery was made in a chamber in one of the mounds to the northeast of the main "teocalli." The top of this mound was overgrown with vegetation and covered with ashes and potsherds. At a short distance below the surface was a cemented floor. Several feet below this floor was a stone wall, and cemented to this wall, above the lintel of a doorway which proved to be the entrance to a tomb, were several pottery vessels. Under each of these vessels was found an idol painted red. The lintel of the door was a slab of volcanic rock, about six feet long by eighteen inches wide, which was covered with strange hieroglyphs. On entering

the chamber, the walls were found to be covered with mural paintings in several colors. The designs were mostly draped female figures in kneeling postures. In the walls of the crypt there were three niches in which were several skulls and fragments of skeletons, all painted red. The entrances to the tombs were in several cases painted red, which seems to have been the mourning color of the Zatopecans. One little arrow head was the only implement or weapon found during this exploration. From the chamber of one of the crypts a terra cotta drain pipe extended far out into the fields. The joints were several feet long and accurately fitted. At Montalban, three miles from Xoxo, are the ruins of an immense structure, built on top of a steep hill, with sunken plazas and underground passageways and great circular pillars. This was evidently the principal fortified city of the ancient Zapotecans.

At a joint session of Section H and the American Folk Lore Society, Mrs. Jeanette Robinson Murphy gave an interesting paper on the "Survival of African Music in America." The paper dealt with African folk tales and superstitions and African songs. The music, as illustrated by Mrs. Murphy from her recollections of her youth in a Southern home, was weird and strange. The folk tales were given in the quaint negro dialect.

Miss Cornelia Horsford presented to the Association the "Evidences that the Norsemen were in Massachusetts in pre-Columbian Days." "These evidences are divided into two series, one geographical, the other archæological." The geographical evidences were shown by taking the description of Vineland in Icelandic literature and applying it to the coast of North America. The archæological evidences were shown by comparing the sites of habitations uncovered in Cambridge on the banks of the Charles, "which correspond with the description of the sites of Thorfinn's and Karlsefni's houses, with work belonging to the Saga-time in Iceland." These remains were also compared with the American works most nearly resembling them in post-Columbian days, "showing that they are essentially like the ancient Icelandic work, and unlike the work of either the native or post-Columbian races on this coast."

Professor B. E. Fernow, formerly Chief of the U. S. Forestry Division, gave before Section I an account of the new "College of Forestry at Cornell University," of which he is the Director. He said that the establishment of this College of Forestry marked a greater development in the science and art of forestry than could be shown in any other direction, since this science was not known,

even by name, fifty years ago, when this Association was organized. Moreover, a memorial to Congress from this Association, twenty-five years ago, led to the establishment of the Division of Forestry in the U. S. Department of Agriculture, which was the first recognition of the science in this country. The handling of slowly maturing crops like forest trees, the speaker said, is a problem wholly unlike any other presented to the business man. The motto of the forester is not "Woodman, spare that tree," but "Woodman, cut those trees judiciously." The aim of the College of Forestry will be "to pull up the stumps of ignorance regarding forests and forestry and to educate professional foresters." The courses leading to a degree of Bachelor in the Science of Forestry occupy four years, of which the first two are devoted to the study of fundamental and supplementary sciences, including mathematics, physics, chemistry, geology, botany, entomology and political economy. The school forest will consist of 30,000 acres in the Adirondacks.

The well-known traveller, Paul Du Chaillu, an invited guest of the Association, gave the members of Section H a paper on "The Norsemen, the Conquerors of Britain." Archæological evidence was brought forward to overthrow the idea that the English-speaking people are descendants of the Anglo-Saxon race. The word Saxon might have come from the name of a weapon, called "sax," which was extensively used by the Norsemen. Proofs were given that the seafaring tribes of the Romans were Norsemen, and reference was made to the exploration of a grave on the river Cam, in England, where "everything was of Norse origin or manufacture, similar to what is found in Norseland." Among these were found Roman coins dating from the year 80 to 220 A.D., which showed plainly that "the Norse tribes were already in Great Britain during the Roman invasion of the island." The speaker regards the Anglo-Saxon race as a myth, and says we should ask the historians to show us their archæology and tell us what country they came from. He believes that we are in great part descended from the Norse race.

At the same session, M. Désiré Charnay, the delegate from Paris, in a few remarks on "The Disappearance of the Cliff Dwellers," advanced the theory that the cliff dwellers were exterminated by the warlike Indians after the latter had acquired the use of the horse, about the end of the seventeenth century. This was as yet no more than a theory, but he thought it might be found to deserve the attention of students.

As befitted the fiftieth anniversary of the Association, the Boston Meeting, according to the report of the new Permanent Secretary, Dr. L. O. Howard, was in many respects the most successful in the history of the organization. Nine hundred and ninety-three members were in attendance, Massachusetts furnishing the largest number, 231; New York the next, 158, and the District of Columbia, 96. Taken together with the members of the affiliated societies, it was the largest gathering of scientific persons ever held in the United States. Among those present there was an unusually large number of noted persons, including nine of the past presidents. There were sixteen members from British North America; an official representative from the French Republic; three guests from Great Britain; one from New South Wales; one from Brazil, and one from Japan.

The Boston Local Committee received words of praise from all sides for the perfection of its elaborate arrangements, so smoothly and successfully carried out, for the entertainment and comfort of the members and guests of the Association. The several receptions and excursions formed an exceedingly attractive feature of the meeting.

A number of interesting publications, which had been prepared especially for the occasion, were presented to the members in attendance at the Boston Meeting. These included an illustrated "Handbook to the Principal Scientific Institutions of Boston and Vicinity," with chapters on Harvard University, Massachusetts Institute of Technology, Boston University, Tufts College, Wellesley College, Boston College, The Lowell Institute, American Academy of Arts and Sciences, Boston Society of Natural History, Massachusetts Horticultural Society, Appalachian Mountain Club, Museum of Fine Arts, Blue Hill Meteorological Observatory, Boston Public Library, Boston Athenæum, Boston Medical Library, Park System, Metropolitan Water Works, Metropolitan Sewerage, Transit in Boston, Geology and Geography of the Boston District and Places of Historical Interest. Another pamphlet was an illustrated "Guide to Localities illustrating the Geology, Marine Zoölogy and Botany of the Vicinity of Boston," containing contributions from five professors and two instructors in Harvard University, Amherst College and Massachusetts Institute of Technology, on the Geology, Physiography, Marine Algæ, Petrography, Marine Invertebrates, and Palæontology of the region. A "Guide to the Peabody Museum of Harvard University" gave a brief description of the Museum, calling attention to the chief points of

interest in the several halls; and a "Guide Book to Harvard University" gave descriptions and illustrations of the principal buildings and points of interest in connection with the University.

The meeting of 1899 will be held in Columbus, Ohio, under the presidency of Professor Edward Orton, President of the Ohio State University. Professor Putnam, the retiring president, will give the presidential address at the Columbus meeting.

# RECORD OF GEOGRAPHICAL PROGRESS.

## AMERICA.

Mount Illimani Ascended.—Sir Martin Conway left England for Bolivia early in the summer for the purpose of exploring the high group of the Andes containing the peaks Illimani and Illampu (Sorata). A despatch received from La Paz, Bolivia, on Sept. 14, announced that Conway had succeeded in reaching the summit of Illimani, which he found to be 22,500 feet above sea-level. He was accompanied by the guides who ascended Mount St. Elias with the Duke of the Abruzzi in 1897.

The highland region in which Sir Martin Conway is working, although not the culminating point of the South American Continent, contains at least the groups of peaks and domes which have the greatest mean altitude. Illampu and Illimani were both known to exceed 21,000 feet in height, and they indicate with sufficient accuracy the central point of the whole Andean system: while the central points of the northern and southern sections of the Cordilleras are similarly indicated by the other loftiest summits of America—in Ecuador, by Chimborazo, long supposed to be the highest mountain in the world, and in the Argentine-Chilian Andes by Aconcagua, the culminating peak of the New World. Mount Illampu is known to overtop Illimani, but the latter summit, though the second highest of Bolivian peaks, is still first in its imposing aspect and variety of outline. Its base is encircled by tropical plantations, while higher up grow the forests and crops of the temperate regions, and above this zone, high beyond the clouds, rise its three snowy peaks, one of which was scaled by Wiener in 1877, and by him named the Pic de Paris. It is not, however, the culminating point of the mountain, which is supposed to be the peak that Conway has now ascended.

A Peculiar South American Telegraph.—The *Geographical Journal* (July, 1898) prints some interesting notes by Col. Church on the visit of Dr. Bach of La Plata, Argentina, who has made extensive explorations in remote parts of the Amazon Valley, giving special attention to the habits and customs of its tribes. Among the Catuquinarú, whom he visited in 1896–97, he found an extraordinary telegraphic apparatus called the *cambarysú*, which these

Indians use. One of them is hidden away in each hamlet occupied by the tribe. A hole is excavated in the ground, about half of which is filled with coarse sand, while above this, almost to the surface, are layers of fine sand, wood and bone fragments and powdered mica. These layers are in a case of hard palm wood which extends above the surface, and there is a hollow space between the underground layers and layers of hide, wood and hard rubber that make the upper part of the apparatus. The rubber top of the contrivance is struck with a club, resembling the stick with which a bass drum is beaten. The instruments are not more than a mile apart, and all are placed in a direct line north and south. When standing outside the building in which one of them is kept it is difficult to hear the blow, though it is distinctly heard in the building a mile distant. The instruments are *en rapport* with one another, and when struck the neighboring ones to the north and south respond to or echo the blow. An Indian at the instrument which thus responds answers the signal, and then the operators are able by a system of signalling to carry on a long conversation.

The Free Zone.—The Free Zone is a narrow strip of territory extending along the northern border of Mexico from the Gulf of Mexico to the Pacific Ocean, and about 12½ miles wide. It was established by Mexico many years ago as a concession to the States bordering the Rio Grande, and a protection against smuggling from the United States. There are a number of cities in the Zone, including Matamoros, Laredo and Nogales, but the total population does not exceed 100,000. Recent Mexican official reports say there are no industries of importance in the Free Zone, which is explained by the fact that manufactures produced there are required to pay the regular duty charges if taken into other parts of Mexico, and the tariff of this country practically keeps them out of the United States. Thus manufacturing industries have to depend upon the limited home consumption. All merchandise imported into the Zone for consumption there pays only ten per cent. of the regular tariff charges, but if shipped out of the Zone into the interior of Mexico, has to pay the additional 90 per cent. of the duties. The Secretary of the Treasury, Señor Limantour, in his report, says: "Many distinguished financiers and eminent statesmen are opposed to the Free Zone, but all recognize the fact that, on account of existing circumstances on the northern frontier, its sparse population, and its lack of resources in agriculture, industry or mining, the privilege could not be abolished without compensation, and the

problem lies in choosing some other advantage without prejudice to the rest of the country. The attitude of merchants in the interior is in general hostile to the Free Zone, because they consider it a privilege granted to only a certain portion of the country; but merchants who are far from the frontier do not consider it injurious. Mexican merchants who are near the Free Zone do not fear its competition, but complain of it because they cannot distribute their goods there without documents and fiscal inspection, as in the rest of the country."

THE MARYLAND GEOLOGICAL SURVEY.—The Baltimore *Sun* says that the Maryland Geological Survey, in coöperation with the United States Department of Agriculture and State Experiment Station, has been making a special study of the distribution of soil types while the geological survey has been in progress. Mr. C. W. Dorsey has been in charge of this phase of the work. The connection between the soils and the indigenous plant life is readily apparent, and the Survey is paying some attention to the distribution of the flora of the State.

WEST INDIAN WEATHER SERVICE.—On July 7th last, Congress authorized the Chief of the Weather Bureau, with the consent of the various foreign Governments concerned, to establish and equip meteorological observation stations at such points in the West Indies and on the coast of the mainland bordering the Caribbean Sea as might be desired. The purpose of this extension of the weather service is to collect and disseminate information of the approach of tropical hurricanes or other storms to the West Indies and our coasts, and to publish such further climatological data as may be of public benefit. Preparations were at once begun, permission to establish the stations was readily obtained from a number of the Governments, and observers were sent to establish the stations. These stations are now in operation at Willemstad (Curaçao), at Santiago (Cuba), at Kingston (Jamaica), at Port of Spain (Trinidad), at Santo Domingo (Santo Domingo), at St. Thomas, at Barranquilla (Colombia), at Bridgetown (Barbados), at St. Christopher (St. Kitts), and at Colon (Colombia). The central station is at Kingston, Jamaica, and all other stations of the system cable daily to Washington and Kingston reports of observations taken at 6 A.M. and 6 P.M., seventy-fifth meridian time. In the event of premonitions of approaching hurricanes special observations are telegraphed. This service was hastily organized to meet a demand on the part of naval and commercial interests for

warning of destructive storms in the Gulf, the Caribbean Sea and the West Indian Islands. Arrangements were made for the prompt transmittal of the information to our fleets in West Indian and Southern waters, and to West Indian and Southern coast ports in threatened districts. Prof. E. B. Garriott, who is in charge of the service, wrote to the *Monthly Weather Review*, under date of Aug. 3:

"The service is not organized for local climatic studies, but it is confidently expected that through the co-operation of representatives of European Governments having possessions in the West Indies, and of the countries bordering on the Caribbean Sea and the Gulf of Mexico on the south and west, a system of weather reporting stations can be permanently established, which will not only permit the forecasting of hurricanes and northers, but allow of such a determination of the climatic conditions as will be a most important factor in developing the wonderfully rich agricultural resources of the West Indian Islands."

## ASIA.

EXTENSION OF BRITISH TERRITORY AT HONG KONG.—The accompanying map from the *Geographical Journal* (Sept., 1898), shows by a broken line the present limits of the territory of Hong Kong controlled by Great Britain. On June 9 the Chinese Government leased to Great Britain for ninety-nine years certain territories on the mainland, opposite Hong Kong, which were needed


to assure the proper protection of the colony and also to provide for commercial expansion. The island of Hong Kong has proved too small for the requirements of its immense and growing trade. The concession includes the whole of the peninsula opposite Hong Kong, as far as a line joining Deep Bay and Mirs Bay as well as the island of Lan-tao. The waters of both bays are included in the list, but

their northern shores are retained by China. The total area is about 200 square miles, all of which will be under British jurisdiction, except within the native city of Kau-lung. China reserves the right to use the leased waters for her own ships whether belligerent or neutral. Fifty years ago the place where Victoria now stands on the island of Hong Kong was a fishing village containing a few scores of squalid huts. On this site is now a splendid city of 250,000 inhabitants, and its prosperity has grown out of the fact that it has represented in the far East the greatest trading nation in the world. It made Great Britain a neighbour of China, Japan, and the islands of the Malayan waters, and, other things being equal, trading peoples are in the habit of dealing more largely with their neighbours than with others. Hong Kong is the great commercial clearing house in the far East. Manila, with its commanding position in relation to all of China's ports from Canton to the Yangtse, may some time rival Hong Kong in this respect.

## AFRICA.

Circumnavigation of Lake Bangweolo.—Mr. Poulett Weatherley, in the summer of 1896, was the first explorer to circumnavigate Lake Bangweolo. His examination of the north-western and western sides constitutes new discoveries. He gained great influence over the natives, and his fearlessness seemed to deeply impress them. As he approached the west shore of the lake at Karoma's *boma* he saw the hills swarming with natives who carried bows, spears, axes and guns. His own weapons consisted merely of a bow and one arrow, but he did not hesitate to jump ashore among the densely packed crowd. Upon an order from their chief the natives paid homage to the white visitor by dropping on their knees and bending their heads to the ground, and the explorer had no trouble with them. In the account of his work printed in the *Geographical Journal* (Sept., 1898), Mr. Weatherley writes that he made no sounding in the lake over fifteen feet. The lake surface, therefore, is usually still, a very strong wind raising only the smallest sea. The lake was formed by the water from the great watershed of the Tanganyika plateau, which gradually overflowed the country at its base. On the east and south-east there is no barrier to check the waters, and in those directions a large swamp from twenty to forty miles in breadth extends beyond the proper limits of the lake. Ranges of hills hem in the lake on its west and south-west coast. Along the north-west coast is an isthmus extending into the lake and connecting points on the mainland about thirty miles apart. The area

enclosed between the isthmus and the mainland is occupied by a large sheet of water called Chifumauli. Bangweolo, the name which Livingstone gave to the lake, is not known in the country. Mr. Alfred Sharpe suggests that the word may have come from Pa-mwelo, which means "at the lake." Mr. Sharpe says that in this part of Africa there is no special name for any lake, the word "Tanganyika" does not really mean any particular lake, but simply a large piece of water. It is the same with the words "Nyassa," "Nyanza," and other words used to designate water surfaces.

Mr. Weatherley draws an idyllic picture of the peace and happiness of some of the densely populated islands. Speaking of Kisi Island, he says nearly all the people in the evening he spent with them were employed in one way or another. They were making and mending mats, beating the bark of the *mitai* tree into cloth, carving pipe bowls, mending bows, smoking or chatting. Women were trooping in from the fields carrying pumpkins, cassava, bundles of firewood or calabashes of water from the lake, balancing all loads on their heads. The sheep and goats were being driven homeward to be penned for the night. War never comes near these happy islanders. They know nothing of the outside world, have all they need and seem to wish for nothing. The explorer expresses the hope that it will be centuries before civilization with its attendant evils robs Kisi Island of its present peace and contentment.

Extending the Telegraph Across the Congo State.—The telegraph line from Boma on the lower Congo to Stanley Pool, a distance of about 300 miles, has been completed. The line is now building between the Pool and Kwa Mouth on the upper Congo. The Government has decided to extend this line clear across its territory from the Atlantic to Lake Tanganyika, and an expedition left Brussels late in August, according to *Le Mouvement Géographique*, to go to Tanganyika by the Nyassa route and begin building the line from the east end. Ten Europeans were in the party, including Mr. Thornton, who has had much experience in telegraph construction in India, Australia, and South Africa. The line, in its central part, will follow the great bend of the Congo.

A Steamboat on Lake Chad.—The Paris newpapers announce the arrival on November 1st last of the steamer *Léon Blot* on the waters of Lake Chad. M. Gentil has, therefore, succeeded in the enterprise which he was sent out three years ago to accomplish, of placing a steamer on the Shari River and Lake Chad. His steamer was taken up one of the northern tributaries of the Mobangi, afflu-

ent of the Congo, and transported by natives across the water parting between the Congo and Shari basins, where it was launched upon the tributary of the Shari River, and then made a successful descent of that river to the large lake on the edge of the Sahara. Near the mouth of the Shari, M. Gentil writes, the lake presented the appearance of a veritable sea, but right at the mouth a number of islands blocked the entrance of the river and nothing is to be seen but grass, reeds and papyrus. No firewood could be obtained on the shores of the lake, though there is an abundance of it on the banks of the lower Shari. On account of the scarcity of supplies M. Gentil was not able to make a complete exploration of the lake, but returned to Baghirmi and the Gribingi, where he wrote the letter announcing the launching of the first steamer on Lake Chad.

## OCEANIC RESEARCHES.

ADMIRALTY SURVEYS IN 1897.—Last year, eight British naval vessels with three small hired steamers, manned by seventy-five officers and 756 men, were employed on hydrographic surveys on the home and foreign stations. The number of newly discovered rocks reported shows no signs of diminishing. Records of no less than 190 rocks and shoals, dangerous to navigation, were received by the Hydrographic Office and due notice was issued to mariners. One of the surveying vessels made a long cruise to Honolulu, via Palmyra and Fanning Islands, to search for reported shoals, survey islands and obtain soundings that would be useful for the proposed Pacific cable. From Fiji a line of soundings was run through the Nanuku passage to the reported positions of the various banks lying near the parallel of 12° S. and extending over several degrees of longitude. The Lalla Rookh, Robbie, Adolph, Turpin and an unnamed shoal were found as well as two other banks, which received the names of Home and Tuscarora. These banks rise from a general depth of 2,500 fathoms and are of the usual coral formation. They vary between three and twenty miles across, and the larger ones show the submerged atoll form. The smaller are flat, with from nine to twenty fathoms of water over them. The general depth of the larger banks is from twenty-five to twenty-seven fathoms. No danger was found on any of them.

THE GREAT WIND AND CALM BELTS.—Mr. R. DeC. Ward, writing in the *Journal of School Geography* (Sept., 1898) of his climatic observations during his recent voyage around South America, speaks of the fact, to which teachers should call the attention of their pupils, that text books and wind charts are apt to give a too rigid idea of

the wind and calm belts and also the limits of the ocean currents. The fact is that travellers rarely pass suddenly from one condition to another, there being no distinct line of demarcation, but rather a gradual change. Mr. Ward illustrates this by the gradual transition he observed between the north-east trade wind and the doldrums, in latitude 10° 2′ N. lat., 44° 2′ W. long. He was there in the middle of June and at that season, when the sun is north of the equator, the north-east trade does not in the part of the Atlantic above indicated extend nearer the equator than about lat. 7° N. lat., the equatorial rainy belt being at this time as far north as this. There were three days of characteristic trade conditions and then came a gradual decrease in wind velocity and an increase in the number and duration of showers, both of which indicated approaching doldrum conditions. On June 15, there was a mixture of trade and doldrum conditions, but the steady, easterly wind all day was a continuance of the trade influence. This combination of the two types where the two wind belts joined was most interesting and the interest was continued throughout the following day (lat. 6° 33 N., long. 42° 39′ W.) which brought the return of trade conditions interrupted by one heavy tropical shower, at 10 A.M. The water temperature of this day reached 83.5°, the highest noted on the voyage, and the air temperature reached 84.9°. Mr. Ward continues:

"The writer read somewhere, years ago, in an account of the doldrum rains, that the amount of fresh water which falls in one of these heavy showers is so great that the surface water of the ocean actually becomes fresh, and he had often, in the course of his teaching used this as an illustration of the remarkably heavy rainfall of those latitudes. The atmosphere of incredulity which pervaded the class-room whenever this story was told caused him to resolve to test the truth of the report at the earliest opportunity. This opportunity came on June 15. After a very heavy shower of half an hour's duration, some of the surface water of the ocean was drawn up in a bucket and on being tested was found to be almost perfectly fresh. The writer can, therefore, assure teachers that they may use this illustration with perfect confidence."

German Deep Sea Expedition.—The *Valdivia* left Hamburg Aug. 1 on its scientific mission around the world. The expedition which was planned by Prof. Chun was organized to make zoölogical, physical, and chemical researches. Last winter the German Parliament voted 300,000 marks to cover the expenses of the expedition and further grants will be made if necessary for the same purpose

and to publish the results. The *Valdivia* was fitted up with bacteriological, chemical and biological laboratories, as well as with instruments for sounding, taking temperatures and samples of deep sea waters, and for dredging and working the plankton nets at various depths. The vessel is as large if not larger than the *Challenger* and the laboratories and work-rooms are more commodious and better fitted with apparatus for scientific investigation than in any previous expedition. The cabins occupied by the scientific staff are handsome and roomy and the large cabin contains a very fine scientific library, including a complete set of the *Challenger* reports. The scientific staff includes Prof. Carl Chun, leader, Dr. Schott, oceanographer, well known for his recent researches on sailing vessels running between Germany and the East Indies, and also a botanist, a chemist, a physician and bacteriologist and three zoologists. The *Valdivia* rounded the north of Scotland and proceeded for Cape Town, Africa, it being estimated that she will be 100 days in reaching that point. After leaving Cape Town, the plan includes an examination of the Agulhas bank and the deep waters to the south; then southward to the edge of the Antarctic ice, returning northward to the centre of the Indian Ocean to Cocos and Christmas Island and to Padang. From Padang, the route leads to Ceylon, Chagos, Seychelles and Amirante Islands, to Zanzibar. Then home by Socotra, the Red Sea and the Mediterranean, Hamburg being reached early in June next year.

OCEAN TEMPERATURES.—Sir John Murray, the editor of the "Results of the Challenger Expedition," has an important paper in the *Geographical Journal* (Aug., 1898) on the Annual range of Temperature in the Surface Waters of the Ocean. His chart takes account not of the mean monthly temperatures, but of the so-called absolute annual range or the difference between the absolute extremes of temperature. From his paper and chart it appears that the lowest recorded temperature reading, at the surface of the sea, is 26° Fahr. in the north Atlantic, east of Nova Scotia, and the highest reading in the open ocean is 90° Fahr., recorded in the tropical Pacific, both north and south of the Equator, though readings of 94° and 96° Fahr. are recorded in the Red Sea and Persian Gulf, respectively. The greatest known range of temperature of surface waters throughout the whole world is thus 70° Fahr. The greatest annual range, exceeding 50° Fahr., occurs over a small portion of the Japan Sea and over the larger portion of the Atlantic Ocean, east of Cape Cod.

The large annual ranges of temperature of the ocean surface, viz., 25° or more in the north Atlantic and north Pacific, undoubtedly represent the influence of the cold north-west winds blowing off shore in winter, as contrasted with the warm, southerly winds blowing on or along shore in summer. The regions of large range are, therefore, confined to the western portions of the oceans and the eastern shores of the continents. The *Monthly Weather Review*, commenting on Dr. Murray's paper, says:

"At first thought one would expect to find in Dr. Murray's lines of equal annual temperature range some traces of the course of the Gulf Stream and Kuroshiwo, but it is only the changes in the positions of these currents that can produce ranges of temperature, and these changes are so largely controlled by the wind that Dr. Murray's charts show principally the effect upon the ocean water of changes in the atmospheric circulation. The same principle applies also to the closed seas, such as the Mediterranean and Baltic, the Red Sea and the Persian Gulf, in all which cases a larger range of temperature is observed at the head of the sea than at the mouth of the sea, due to the fact that the highest temperatures occur at the head when the wind blows towards that direction in the summer and the lowest when the wind blows in the opposite direction, at the opposite season of the year. There is, therefore, in this map no comfort for those who maintain that the Gulf Stream or the Kuroshiwo, respectively, alleviate or control the temperatures of the eastern portion of the Atlantic and Pacific oceans and the adjacent portions of Europe and America. Everywhere we see that it is the wind that controls the temperature of the surface of the ocean and then carries this ocean temperature inward over the land. The same remarks apply to the southern hemisphere, where Dr. Murray's chart shows that the greatest range of ocean temperatures is in the region where there is the greatest annual range of wind direction."

## POLAR REGIONS.

SPITZBERGEN CIRCUMNAVIGATED.—The London *Times* (Sept. 22) says that the *Antarctic*, with the Swedish Expedition under Dr. A. G. Nathorst, has returned to Tromsö, after a highly successful cruise to the seas and islands around Spitzbergen. The *Antarctic* left Tromsö on June 8 and reached Bear Island on the 11th. A week was spent there. The whole island was surveyed, and an excellent map on a scale of 1:50,000 was drawn by Lieut. Kjellstrov and Dr. Hamberg, which shows that the old maps are quite incorrect. The

geological work was also successful. Previously only carboniferous strata were known, and an old rock without fossils. In this rock, however, the expedition found fossils, showing the age to be Silurian. Another series was also discovered, the age of which is probably Devonian. The geologists discovered fossils in the "Three Crowns," forming the top of Mount Misery, which will probably prove to be of Jurassic age. The geology of the little island is consequently of great interest. Some new zoological and botanical discoveries were made. The *Antarctic* went east of Spitzbergen to ascertain the position of the ice-pack, but, as was expected, the ice did not permit of the expedition reaching King Charles Land. They consequently sailed round the west of Spitzbergen, when Bell Sound was surveyed and mapped, a most necessary work, since the old maps of Van Myen Bay (Bell Sound) are very incomplete.

After having visited some points of interest in Ice Sound, the expedition proceeded westwards and did some hydrographical work as far as the margin of the Greenland ice-pack (78° 1′ N. lat., 4° 9′ W. long.). Thence the ship was turned to the south and east of Spitzbergen, and reached King Charles Land, which was completely covered by an ice-cap, broken off at the sea shore and ending in a perpendicular ice wall, just as is found in the Antarctic Continent, though in miniature. Great table-formed icebergs are given off from this ice-sheet.

From White Island, which is larger than indicated on the maps, the *Antarctic* made its way through alternating heavy ice and open water to Charles XII. Island, whence the expedition proceeded northwards and reached 81° 14′ N. lat. Had the expedition been there a fortnight earlier it would certainly have reached a higher latitude, but northerly winds had prevailed for some time, so that the pack had been driven south. The expedition then passed north of the Seven Islands and proceeded to Treuenberg Bay, Grey Hook, and Danes Island, from which they steered southwards along the western coast of Spitzbergen. When the *Antarctic* reached the south end of Prince Charles Foreland, the circumnavigation of the whole of Spitzbergen, with the surrounding islands, was completed. Probably no vessel has ever done this before. Dr. Nathorst's intention to go to Stor Fiord was rendered impossible through heavy gales, and, having waited in vain for about a week for the weather to improve, he steered southwards, passing Bear Island again and doing hydrographical work. The scientific work of the expedition has been most successful. The party have brought back large geological, botanical and zoological collections. The geology,

botany and zoology of King Charles Land are now completely known, and there are evident important connections between the geology of Spitzbergen and that of Franz Josef Land.

THE GLACIERS OF SPITZBERGEN.—Sir Martin Conway has described his work in 1897 among the Spitzbergen glaciers, in the *Geographical Journal* (Aug., 1898). He regards as the principal geographical result of his second expedition to this island group the discovery that no large part of Spitzbergen, except New Friesland and North East Land, is covered by an ice-sheet. The old idea of Spitzbergen was that its interior consisted of a great ice-sheet fringed at the edge by a number of boggy valleys and green hillsides. His explorations have shown the falsity of this conception, as the larger part of the region consists of glacial and mountain areas, to which the term inland ice does not apply, as the juxtaposition of any number of glaciers does not form an ice-sheet, but merely a glacial area.

SPITZBERGEN WITHOUT AN OWNER.—No nation has ever yet claimed Spitzbergen as its own, though the people of Sweden and Norway seem to regard it as a part of their kingdom, because it lies nearest to their coasts and has been explored chiefly by them. The *Geographische Zeitschrift* says the Russians have recently put forward some claim to the group in consequence of the invitation of the Swedish Government to join in the measurement of an arc on Spitzbergen. The group has an area of 27,000 square miles and though uninhabited it is by no means valueless, the region being rich in minerals, such as coal, iron, marble and graphite. There are indications also of the existence of gold. The seal and other fisheries have been and still are of great importance and demand State regulation to prevent their total extinction.

MR. WELLMAN'S EXPEDITION —Mr. Wellman left Tromsö on June 27 for Franz Josef Land. His party includes Prof. J. H. Gore of Columbia University, Mr. Evelyn B. Baldwin, Dr. Hofma, and Mr. Quirof Harlan of the United States Coast and Geodetic Survey. It is Mr. Wellman's intention to advance northward from Cape Flora and, if possible, beyond the place where Nansen wintered, where he will build a hut and spend the dark season. Next spring he hopes to go on towards the North Pole, but if conditions are not favorable he will wait till the following spring. It is gratifying to hear that the meteorological observations of Mr. B. O. French of the Coast and Geodetic Survey and Dr. H. Alme of the Meteoro-

logical Office at Stockholm, north of Spitzbergen on the first Wellman expedition, are to be printed as a bulletin of the Weather Bureau. Competent observations at points so isolated and so far removed from the regular meteorological stations should be printed in all detail, as they may be of much value in tracing storms and weather over the North Atlantic.

Proposed Expedition to Sannikoff Land.—Baron E. von Toll has outlined the plans of an expedition which he desires to lead to Sannikoff Land, north of the New Siberia Islands, next year. Between 1805 and 1811, Jacob Sannikoff, a Yakutsk merchant, made a series of bold journeys to the New Siberia Islands, of which he was one of the discoverers. He spent a full summer on the northern island of the archipelago and sighted two lands to the north, which were indicated on the map of the islands that was produced by the topographer Pshenitsyn. A few years later Lieut. Anjou, who was sent out by the Russian Government to settle more definitely the topography of the archipelago, was not able to get a view of the lands sighted by Sannikoff, who had made two unsuccessful attempts to reach them by sledging over the sea ice. After Anjou's last sledge journey along the northern coasts of New Siberia, he returned in 1823 and reported that there was no land to the north of the archipelago which could be attained with the means at hand. So the "Land sighted by Sannikoff" disappeared from the maps until about sixty years later, in 1881, when the De Long expedition discovered Bennett Land, which is undoubtedly the land that Sannikoff sighted from the High Cape of New Siberia. In 1886 Baron von Toll was able to convince himself of the existence of the land that Sannikoff saw to the north of Kotelnyi Island. Baron von Toll saw from the mouth of the Mogur River the sharp outlines of four truncated cones, like table mountains, from which a low foreland extended towards the east.

In his paper he discusses the geological bases for believing that Sannikoff Land belongs to an undiscovered archipelago, which may possibly have the size of Franz Josef Land but hardly the size of Spitzbergen or Greenland. He desires to explore this archipelago and to study it in its various scientific aspects, with the collaboration of an astronomer, a meteorologist and a topographer, and a few Yakuts or Tunguses to act as hunters and dog drivers.

Antarctic Exploration.—Lord Salisbury, in reply to a letter sent to him by the Royal Geographical Society, urging upon the Government the duty of England to complete the work of explora-

tion in the Antarctic regions, begun by Ross half a century ago, has finally replied that he is not able to hold out any hope of the British Government "embarking upon an undertaking of this magnitude." It has also been ascertained that there is no prospect of any joint action from the Australian colonies. The Council of the Society, feeling that it is the duty of Great Britain to explore the vast region still unknown in the Antarctic, has authorized the President to take steps to obtain the necessary funds, not less than $250,-000, towards which the Society would contribute $25,000.

Mr. Borchgrevink departed early in the summer for the scene of his proposed explorations in the neighborhood of Victoria Land, in the Antarctic, where he expects to be engaged for two years. The funds for his expedition were provided by Sir George Newnes. His Ship is the *Southern Cross*, which has already sailed in Antarctic waters. Captain Bernherd Jensen is in command, with two mates and a crew of twenty-four. A strong scientific staff was engaged, including Captain Kolbeck and Mr. Louis Bernacchi, as magnetic observers; Herr H. Klövstad, of Christiania University, as medical officer, and Messrs. N. Hansen and Hugh Evans, as zoologists.

## WASHINGTON LETTER.

WASHINGTON, D. C., OCTOBER 12, 1898.

SURVEYS IN ALASKA.—Several of the parties of topographers and geologists who were in Alaska during the summer have returned to the United States, reaching Seattle early in October, and the remainder are expected to follow shortly. Mr. Edwin C. Barnard's party of 16 men, reaching Lake Bennett in April, spent nearly a month waiting for the ice to break. They finally arrived at the mouth of White River in June, leaving Mr. William J. Peters, topographer, and Mr. Alfred H. Brooks, geologist, who with 4 men turned up White River, mapping the country and making a geologic reconnaissance. This party found a low pass occupied by a wide marsh and leading to the headwaters of the Tanana. The three canoes were transported over this marsh and the trip down the Tanana was begun the latter part of July. Triangulation was carried along the banks of this river and the topography sketched until the prevailing smoke prevented further work of this character. Beyond this point stadia measurements were continued nearly to the Yukon. It was arranged to reach this latter point on the first of September, and it was found necessary to drop the stadia measurements and make a hasty circuit in order to reach the Yukon on the date set. A short time after reaching the mouth of the Tanana the party boarded one of the Yukon River steamers and arrived at St. Michael early in September. In the meantime, Mr. Barnard's party proceeded down the Yukon from the mouth of White River, and crossing the international boundary into Alaska, mapped a quadrangle, covering one degree of latitude and longitude. When this work was completed, Mr. Barnard proceeded down the river and reached St. Michael just in time to leave for Seattle with the first party.

Mr. Eldredge proceeded to Cook Inlet and up the Sushitna River with the intention of crossing a path to the Tanana, but owing to various unforeseen contingencies did not succeed in doing this. After making a thorough examination of the country and obtaining results of value, he returned southerly and took passage from Toyonak on Cook Inlet by the first available steamer, reaching Seattle on October 8. Mr. Spurr, who had left Mr. Eldredge's party with the

intention of going westerly down the Kuskokwim River, succeeded in carrying out his plan, and reaching tide-water, sent three men across the portage to Yukon River and to St. Michael. He, with two others, took a sailing boat with the intention of coming southerly into Kuskokwim Bay and easterly to Bristol Bay and Iliamna Lake, with the object of reaching some port on Cook Inlet.

EXPLORATIONS IN THE SOUTHWEST.—Dr. J. Walter Fewkes, of the Bureau of American Ethnology, a branch of the Smithsonian Institution, has left to continue his studies of the Pueblo Indians of northeastern Arizona. In preceding years he has acquired a familiarity with the languages and customs, such that he has been admitted to various secret or semi-religious organizations among the Indians. By a careful study of their traditions he has been able to trace out the migrations of the Mokis and has identified the ruins of ancient towns. From these he has obtained a large and valuable collection of ancient pottery, implements, and other articles, which during the past year have been arranged and placed upon exhibition in the National Museum. In connection with this he has also prepared a series of papers which are being printed in the annual reports of the Bureau of Ethnology. The work now under way is intended to extend the knowledge already gained, particularly of the ceremonials which, while now practised, are being rapidly modified or outgrown.

INTEROCEANIC CANALS.—The Nicaragua Canal Commission, of which Admiral Walker is president, has returned to Washington and established offices in the city, where presumably the official report will be prepared for early presentation to Congress. Nearly all of the engineers and employés have been brought in from the field with the exception of two parties, one under the charge of Mr. Arthur P. Davis, continuing the study of the hydrography of the route traversed by the canal, and the other under Dr. C. Willard Hayes, making borings for sites for dams and studying the rock structure. The data being brought together and digested by these specialists are of a character that has been almost neglected in previous surveys, and yet are of such fundamental importance that all estimates must of necessity rest upon them. In the earlier reports various assumptions have been made as to the probable water supply and the possible character of the rock and earth, but from lack of precise data the points have been lightly touched upon, although involving the whole question of feasibility. It has, therefore, been the desire of the present Commission to give particular

attention to these points in order that these great sources of uncertainty may be removed.

While the Nicaragua project has been attracting public attention the Panama scheme has been quietly investigated, and it is probable that about the time the report of Admiral Walker appears there will be an exhaustive discussion of the merits of the canal at Panama. The new Panama Canal Company, organized in October, 1894, has employed a technical commission consisting of French, English, German, Russian, and American engineers. These have made a thorough examination of the present condition of the Panama Canal and have prepared many elaborate alternative plans and estimates sufficient for the determination of the questions as to the method and cost of final completion. It is stated that about 40 per cent. of the whole length of the canal has been actually excavated. Many advantages are claimed for the Panama route over the Nicaragua, particularly in the fact that good ports already exist at each terminal of the former, while in the case of the latter they must be artificially prepared.

STATISTICAL ATLAS.—The Statistical Atlas of the United States, prepared by Henry Gannett, and based upon the results of the eleventh census, has been issued and is now being distributed. Work upon it was completed in June, 1896, but the preparation of elaborately colored maps and diagrams and various difficulties have operated to delay the final publication. These illustrations are accompanied by sufficient explanatory text to make the meaning clear, but it is surprising to note what a wide range of information is conveyed in an easily comprehensible form by graphic methods. The development of the country and the increase in population as a whole and by States is shown by a series of maps, and the original nationality, the migration of the people, their health, religion, occupation, and wealth, brought out by various color schemes. One of the most striking items is the distribution of the foreign-born population of the United States with reference to the countries from which these people came. Natives of the Germanic nations are shown by the maps to have concentrated around the western shores of Lake Michigan and in the country northwest of this, while the Scandinavians have gone still farther to the northwest into Minnesota and the eastern part of the Dakotas. The natives of Ireland, on the contrary, are found for the most part consolidated along the Atlantic Coast, in the southern New England States and New York, so much so that in Massa-

chusetts, Rhode Island, and Connecticut the persons born in Ireland constitute nearly one-half of the foreign-born population. The inter-State migration is illustrated by a series of small maps which show by appropriate colors the other States, into which the natives of a particular State have gone. For example, beginning with Alabama, a glance at the map shows that most of the natives of Alabama, who have left that region, have gone to Mississippi and to a less extent to the adjacent States as far west as Texas, comparatively few going north. On the other hand, the natives of Connecticut have spread out westerly into Ohio and Illinois, and through the northern half of the United States to the Pacific Coast. The trend along parallels of latitude or lines of similar conditions of temperature is fairly well marked. The yield of various farm crops is elaborately discussed by maps, and following this the condition of manufacturing, as well as the wealth and indebtedness of the country. If fact, nearly every matter of importance to the country as a whole has been illustrated in its most striking form. Even a casual inspection of these maps and diagrams reveals many facts of interest or surprise, and a thorough study of them enriches the mind.

WESTERN NEBRASKA.—A copiously illustrated report upon the topography and geology of western Nebraska has been prepared by Mr. N. H. Darton, and is being printed in Part IV. of the Eighteenth Annual Report of the United States Geological Survey. This area being traversed by but few railroads has been little known. In many respects it is similar to western Kansas, but, as it lies well within the semi-arid or even the arid region of the country, it has not passed through the cycles of "booms" and depressions which have characterized its more southern neighbor. Settlement has progressed slowly, and, with the exception of the cattle ranches, has been confined mainly to the valleys of the North Platte, Niobrara, and White Rivers.

One of the most striking features of this country is the great area of sand hills. These have been considered almost, if not quite, worthless except for grazing purposes. The sand is in small hills, irregularly grouped, and rising to a height of 50 to 100 feet, or even more. The area capped by them is estimated at 24,000 square miles, or three times the extent of the State of Massachusetts. The hills and ridges are irregularly scattered over the surface, often so closely grouped as to encroach upon each other. For the most part they are moving slowly toward the southeast as the sand is blown forward by the prevailing winds. The surface is

usually covered with a somewhat scanty herbage, retarding the drifting of the sand. Many of the grasses furnish excellent forage, and large herds of cattle find sustenance in this part of the State. On some of the higher or more exposed hills the winds have been able to break through the covering of vegetation and, getting at the soft sand, to dig this out, forming what are locally known as "blow-outs." These blow-outs rapidly eat their way forward, the sand being transferred from the steep face up over the top of the ridge and deposited in gentle slopes to the leeward.

The rain falling upon the sand-hill area sinks in immediately and cannot establish drainage lines. Penetrating downward and laterally it saturates the lower layers of the sand where these rest upon comparatively impervious clays. The water plain thus formed occasionally rises so high as to result in small ponds or pools in the deeper valleys among the hills. In many places water can be obtained by merely scooping out the sands of the lowlands. Although the soil is so light, yet recent experience has shown that crops can be raised. By applying some of the water which can be pumped from beneath the surface, gardens or small farms have proved remunerative. Thus the sand-hill region, once classed as desert, has been found to possess many resources which can be turned to advantage.

The Bad Lands.—During the past summer the examination and study of the Bad Lands east of the Black Hills has been carried on. In spite of their name the Bad Lands of South Dakota are among the most attractive of the scenic features of the West. They have been little known and rarely visited except by collectors for museums—or 'bone hunters," as they are commonly known. These lands owe their origin to the existence of thick deposits of sand and clay, of comparatively recent origin geologically, and having a relative hardness such that they are eroded with extraordinary rapidity by the occasional showers of the arid region. Beds of similar character and age, if situated in a humid area, would have been washed away centuries ago, but in a dry country, where the drought is broken only by downpours at long intervals, these beds have been cut into the most fanciful forms. They lie almost horizontal and on top present the aspect of grass-covered flats, being portions originally of an extensive prairie. In driving along on top of these remnants a person has the impression that he is upon a great plain stretching to the horizon. Suddenly, however, and almost without warning, he reaches the edge of a great cañon opening at his feet to a depth of several hundred feet, and with walls most beautifully

sculptured with buttresses and pinnacles. At the bottom is a nearly level valley, beginning abruptly at the foot of the cliff and without the usual talus slope. This latter feature is one of the most surprising in the erosion of the country. The soft sands and clays when broken down are apparently carried off immediately and the lower plain—that of the valley—is continued to the very bottom of the cliff, which rises to the ancient and disappearing plain. Between the two are the almost vertical walls, which can be climbed in only a few places. Across the Bad Lands trails and roads have been made by the Indians, so that following these a person may drive or ride a bicycle, the path extending either along the valleys or on the upper plain. If on the latter, he may pass through the Bad Lands almost without seeing their wonders, as his eye rests mainly upon remnants of the old surface. In attempting, however, to go across out of the beaten tracks, progress is soon found to be blocked by the abrupt cliffs and, should the traveler succeed in climbing in and out of one of these cañons, he would usually find others blocking his progress in the most bewildering fashion, so that he may travel across or around the head of these for hours and make little onward distance.

In the walls exposed by erosion are to be found the remains of gigantic land animals and of turtles. The latter are to be seen almost everywhere, some of great size, two feet or even more in diameter. Occasionally a turtle shell is found capping a low pillar formed by the harder shell protecting the soft rock under it from erosion. The great massive bones and teeth of the *titanotherium* are common, and in the higher beds those of the small and apparently graceful *oreodon*, one of the predecessors of the modern horse. The teeth and other parts of carnivorous animals are also found and the great variety of well-preserved bones has attracted the attention of collectors for museums, so that through the labors of Marsh, Owen, and Cope, the region has been known as a rich field for the palæontologist, rather than for the attractions which appeal to the ordinary tourist or traveller. Access to the region is comparatively easy from the railroad stations to the east of the Black Hills, and the roads are for the most part excellent. The superb climate and wonderful views must in the future attract the seeker for the novel or the beautiful, especially when the results of the surveys now being conducted are available for general use.

Southern Ute Reservation.—In the Act making appropriation for the expenses of the Indian Department, approved on July 1, 1898, it is provided that the Secretary of the Interior shall make an

investigation as to the practicability of providing a water supply for irrigation purposes on a portion of the Reservation of the Southern Utes. This tract of country lies in the extreme southwestern corner of the State of Colorado, draining into Mancos River, which in turn flows into the San Juan River, a tributary of the Colorado River of the West. An expenditure of upwards of $150,000 was authorized for the purchase of water, if it can be had from some company already in existence. The carrying out of the terms of this Act will mark a notable advance not only in the development of the resources of the West, but in the settlement and partial civilization of some of the Indians regarded as least amenable to the customs of white men.

The occupants of the Reservation are known collectively as "Southern Utes" as distinguished from the Uncompahgre Utes and others of northern Utah. They consist of remnants of tribes known as the Kapoti, Muachi, and Wiminuchi Utes. In numbers they aggregate about 1,100, of whom about 400 nominally have permanent homes or allotments upon which they are supposed to live. The remainder have homes temporary in character and spend much of their time wandering over the Reservation, or on the neighboring mountains and desert plains. The total area of the Reservation is over one million acres, some of the land being of high fertility and capable of producing large crops if water can be had for irrigation.

Much of the Reservation, however, lies within the great mesa land, deeply dissected by the Mancos River and its tributaries. In the edges of the cañons thus formed are the wonderful cliff houses, and scattered through the valleys and over the high tablelands are innumerable ruins of houses and towns of unknown antiquity. It is almost impossible in this part of the country to find an acre or even a square rod of ground upon which there is not some bit of ancient pottery, or fragment of dressed stone, or other indication of the former presence of a considerable population. The Indians now occupying the country are totally ignorant of their predecessors, although recognizing the fact that people of a higher order of manual skill at one time inhabited these ruins. Fortunately the Utes, as well as the Navajoes and other tribes, have a respect, or more properly a superstitious dread, for the cliff houses, and, unless accompanied by white men, cannot be induced to approach them. It is related that an Indian guide, one who had been to school and could talk English, piloted a party of explorers to one of the largest ruins. While he was absent on some errand the white men discovered a mummy of one of the former residents of the town, and bringing it down from the cliff,

set it against the waggon. Upon returning, the Indian, coming unexpectedly upon the mummy, started back in fright, leapt on his pony and was last seen in a cloud of dust on the far horizon, never returning for his pay or personal belongings. This fear has operated to preserve these ruins for hundreds of years or until the advent of the cowboy and occasional tourist, the destruction wrought during the last decade being greater than that of many centuries.

It is obvious that the climate of this part of the country was probably no less arid in former times than at present, and that the people who built the houses now in ruins must have subsisted largely by agriculture, as there is no evidence that game was particularly abundant. The remains of corn and other cereals in the ancient villages show that these must have been cultivated, and there are not only traces of ancient irrigation ditches, but indications that some of the steeper hillsides were laboriously terraced and presumably highly cultivated. In other words, a large population lived in apparent comfort, where now a few Utes seem to be in danger of starvation. If these latter can be induced to practice some of the arts of their predecessors, there is every reason to believe that they will become self-supporting, thus relieving the Government from the necessity of doling out at regular intervals flour, bacon, and other provisions. To induce a people who have been pauperized by the issuing of rations to work and think for themselves is a difficult task, and one requiring that every possible facility be used. The small economies and careful conservation of moisture, which the ancient people evidently practised, do not at this time seem to be feasible, and therefore the Government has determined to provide an ample supply of water and to make the start of the Southern Utes on the road to civilization as easy as possible.

On the eastern end of what was formerly the reservation is a comparatively good supply of water from small streams flowing southerly from the La Plata Mountains. Here in the vicinity of Ignacio the Government has built a number of irrigating ditches and has, through the efficiency of the former Indian Agent, David F. Day, succeeded in inducing a number of Utes to cultivate their farms, the work being under the advice or supervision of an active farmer. The remaining members of the tribe have, however, refused again and again to take land in allotments and have held out against persuasion and inducements offered. They see no reason why they should work for themselves when the Government has

agreed to support them and their children, and in this they have been advised by the neighboring whites, for whose interest it has been not to permit the Indian to become a citizen and self-supporting individual. The efforts of the Government to better the condition of such tribes, not only against their natural inclinations, but also against the active opposition of the white neighbors, must be of the most vigorous character in order to make a decided change in the existing conditions.

The Southern Utes at the present time have little property beyond a few personal adornments and a small band of sheep. They own, unfortunately, a good many worthless horses, whose only use is to transport them from point to point, facilitating their restless wandering in the visits made by one family upon another, or upon distant tribes. If they did not have these it is probable that they would be more inclined to stay at home and to accumulate personal possessions, but, mounted on their ponies, a man with his wife and children will start off on a journey of several hundred miles to visit some distant relative or acquaintance, staying until the food supply of the person visited is exhausted, and then visiting in turn others, and finally coming back to the recognized family home, in which, however, but a few weeks of the year may be spent. Formerly the tribe, or small bands comprising the tribe, owned considerable numbers of cattle and sheep, but mismanagement on the part of the Indians and of various agents and authorities resulted in the loss of the cattle and most of the sheep, the horses alone being left.

The Indian customs are against the accumulation even of horses, for although these people, unlike many tribes, will not eat horse flesh, many horses are killed upon the death of some prominent chief or other individual. During this last summer one of the head men was very sick and his relatives began to kill his horses, fifteen being slaughtered before it was discovered that he showed signs of recovery. These horses were thus, even according to the Indian's belief, needlessly destroyed and did not enure to the chief's benefit in the next world even when he did die. Delicate questions of ethics have been brought up for the decision of the Indian agents on occasions such as these, as, for example, when sheep are killed on the death of a chief, as to whether the hides can be sold. The final conclusion, as reached by counsel called for the purpose, was that the sheep should not be skinned, as a man in the spirit world would be ashamed to be seen by his friends herding a lot of sheep without their wool. The Indian is thus hesitating between his ancient beliefs and the obvious necessity of adopting the white man's way

of looking at things. It is probable that if the surveys now being conducted upon and adjacent to the Reservation show that ample water can be had and the recommendations are carried out, one individual after another will probably try to raise a crop in the white man's fashion. But it is highly necessary that these first experiments should be successful, for failure at the start quickly discourages the Indian. When once the individual has broken away from his ideas of etiquette and hospitality, and has taken on the white man's covetousness and desire to own and possess personal property, it will be practicable to hold him to one spot of ground and put him in the way of becoming a citizen.

Two Arid Regions.—At this time it is interesting to compare the arid regions of the Old World and their development with corresponding areas in the New, taking as an example Spain as a representative of the drier part of Europe and California as a corresponding example in our own country. The area of Spain in round numbers is 197,000 square miles, or about one-fourth larger than that of California, this being approximately 156,000 square miles. The population of Spain is about 17 million, while that of California, as shown by the census of 1890, is only a trifle over one and a fifth million, or about seven per cent. that of Spain, the density of population per square mile being respectively 90 and 8. The State of Ohio is in this respect comparable, it having an average of a little over 90 people for each square mile of its land surface.

If we should take the entire population of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York and New Jersey, and move all of these people into California, we would then have in that State an aggregate about equivalent in number to the total population of Spain. The point of comparison, however, is in the climate and the natural resources of the two areas. These have striking similarity, and if the old country can support such a great population it is to be inferred that with as fertile a soil, as favorable a climate, and as great mineral resources, the State of California may ultimately have not only a population numerically as great, but, due to better institutions, far higher intellectually. In both countries the rainfall of the greater part of the area ranges from 10 to 15 inches per year, in some portions amounting to 20 inches or even more. The more southern valleys have a semi-tropic climate favorable for the production of citrus fruits. The water supply is relatively small and sparsely distributed, and the rivers have less value for navigation than for use in

filling the irrigation canals and ditches of the farmers. Both countries, though depending largely for their agriculture upon a continuous water supply, have suffered severely from the lack of suitable laws governing the distribution and use of water, and future developments are being crippled by the uncertainty regarding this form of property.

A recent report of the Department of Agriculture exhibits the source of the wealth of Spain resulting from exportation. The total annual exports from 1881 to 1895 have averaged about 150 million dollars. Of this amount the principal item was for wines, averaging about 30 million dollars per year; next to this were mineral ores, 15 million dollars; and metals, mainly copper and lead, 17 million dollars. Fruits and nuts, both fresh and dry, aggregate 13 million; olive oil over 3 million; and cork, mainly in the form of stoppers and boards, over 4 million dollars. Nearly all of the agricultural products which have really formed the foundation for the development of Spain's population can be grown with equal success in California or portions of Arizona, New Mexico, and adjacent States. The natural resources are there awaiting the wise treatment which may render them available to the largest number of future citizens. N.

# MAP NOTICES.

BY

HENRY GANNETT.

The U. S. Geological Survey has issued five sheets recently. Two of these, known by the titles of Tolchester and Choptank, are in Maryland, and are upon a scale of 1:125,000, with contours having an interval of 20'. The first of these lies just east of Baltimore and includes considerable areas upon either side of Chesapeake Bay. The land west of the bay lies just above the fall line, and shows a country which has been base-levelled, elevated and subsequently dissected. Ths eastern shore of the bay is composed of the low, young country of the Atlantic plain, now in process of subsidence.

The Choptank sheet includes Annapolis in its northwest corner and a considerable area of the Atlantic plain upon the east side of the bay.

The first sheet from the survey of Indian Territory has appeared. This is known as the McAlester sheet, and is upon a scale of 1:125,000, with a contour interval of 50'. The town of McAlester is near its northern edge. It represents a region of narrow, rather crooked ridges, the general trend being northeast and southwest, being the westward continuation of the Ozark ridges. These ridges are mainly of sandstone, the valleys separating them being of limestone. It is a region quite similar in structure and in the effect of erosion to the Appalachian valley, having been greatly folded and faulted and subjected to erosion for a long period.

In Colorado is one sheet, Durango, in the southwestern portion of the State, upon the southern slopes of the San Juan Mountains. This sheet is on a scale of 1:62,500 with contours of 100'.

From Utah is one sheet known as the Tintic special sheet. It is upon a scale of 1:62,500, with a contour interval of 50'. It includes the Tintic mining district, with Tintic valley upon the west and Goshen valley upon the east. These are desert valleys without outlet, and the wash from the mountains has been deposited in them, filling them to great depths with detritus. Most of the streams flowing from the mountains have built up beautiful, although small, alluvial fans.

The U. S. General Land Office has published a map of Alaska, upon a scale of 48 miles to 1 inch, on which relief is expressed by crayon shading. The map is, in the main, a copy of that published by the Coast Survey with a little additional geographic information, such as the routes of travel, the location of missions, boundaries of land districts, mineral discoveries, etc. A rather premature attempt is made to show the isotherms of the region. The economy of preparing this map is questionable since it contains very little of a geographical character which is not shown upon the Coast Survey map, and nothing of an economic character which is not better shown upon that of the Geological Survey.

## BOOK NOTICES.

*Natural Advanced Geography. Jacquès W. Redway and Russell Hinman, American Book Company, 1898.*

The Natural Advanced Geography, supported as it is by two names so well known for their success as book makers, attracts an attention that is not usually given to school geographies. The book well deserves the attention it has received, for it contains much that is new and of interest, though it does not cut out a path for future text book writers. Though *man* is announced as the centre around which the book has been constructed, we cannot see that man is over emphasized or that he appears much more prominently than in most text books. There is still room for some future book that will emphasize the human relations to the earth, but in a strictly casual way, so that geography may still be as it should, geocentric. At present there is a tendency to make our geography work anthropocentric, as if we were primarily teaching anthropology or sociology, rather than geography.

The book as a whole is well arranged and pleasing in appearance, and readily usable. The uniform scale for maps is especially to be commended, as is also the careful placing of the illustrations so that they refer to the text, and furthermore to the text immediately adjacent. The illustrations are numerous and usually well chosen. The general appearance of the book is much marred, however, by the difference in quality of illustration in the first and last parts, and much would have been gained had a plate process been adopted for the pictures of our own country. As illustrations are to *illustrate the truth*, it is very unfortunate that so many ideal drawings on a bad scale should be adopted. Oxen that reach to a man's waist, and kangaroos as big as trees are hardly true to nature.

We find the usual lack of proportion in the amount of space devoted to the different parts of the globe so that the United States is emphasized until it may well seem as a recent critic has said "synonymous with the world." We also note the usual questions in the text that are answered in the next paragraph and the questions at the end of the chapters that any teacher who can use the book intelligently would never have need to employ. The suggestions for correlations and comparisons and for supplementary reading are on the whole very good and valuable, particularly when they emphasize the reasons for conditions. A well equipped teacher who

has a wealth of extra knowledge at her command for elaboration and illustration can use this book better than almost any other for making her pupils study the relations of cause and effect.

Some teachers will probably be surprised to find that the latest geography announces only *three* continents, and with reason, for it is an unusual usage. It should be said, however, that the authors have been consistent in this use throughout the book. The principles of the modern physiography have been adopted to a certain extent, and occasional summaries of land histories as given under the United States are excellent. We wonder, however, why the authors should adopt and use the word *peneplain*, which some scientists are still opposing, and should fail to use such simple, helpful and self-explanatory terms as *drowned* and *distributary*.

There are occasional statements of fact that we should question, but they are not numerous. The origin of dew as given on p. 14 is hardly adequate or complete, and the use of "Appalachian ridge or valley belt" to include the crystalline mountains to the east is an unfortunate extension of the term not warranted by the geographical history. The same may be said of the use of Prairie plains to include the Prairies and Great Plains. Furthermore, the description of the Great Plains as a part of the Rocky Mountain Highland, though necessary after the adoption of 2,000 feet as the upward limit of a lowland, includes two very dissimilar parts and separates the Great Plains from the eastward Prairies that have been formed under the same conditions and at the same time.

These are some of the questions of difference of opinion with which, perhaps, one should not quibble. When a book has so much to commend, however, it is natural to wish that the authors had gone a little farther, if for no other reason than to preclude the possibility of some new book to bring out a few new points and to add one more to the large list of available school geographies. In conclusion, we would say that any school not now using one of the two or three best books on the market, would find this book perhaps the best for introduction. It will be particularly successful in those schools where the teachers are not able to bring in much of the so-called "new geography." We should not advise other schools to exchange "an old lamp for a new"—for the book in question is not sufficiently in advance of its best competitors to warrant such exchange. The series of two books, the Elementary and Advanced, forms a logical and progressive combination, with less of a break between the books than in any other series we know.

R. E. D.

The longest paper in the *Revista* of the Museo de La Plata, Tomo VIII, is by the Director of the Museum, F. P. Moreno, on a topographical and geological examination (in 1895–96) of the Territories of Neuquen, Rio Negro, Chubut and Santa Cruz, all in the Andine region of Argentina.

The surveys extended over an area of 7,155 sq. kilometres, between the parallels of 36° and 46° 30′ S., and west of 70° 30′, West Longitude. There were 3 determinations of longitude, 328 of latitude and 201 of azimuths, 360 stations fixed with theodolite, and 180 with the prismatic compass. The trigonometrical observations of altitude numbered 271 and the barometrical observations 1,072. The party brought back 960 photographs, besides 6,250 specimens of rocks and fossils, and collections of the fauna and flora and anthropological objects.

The district between the River Limay and Lakes Lacar and Nahuel-Huapi, previously unknown to geographers, was surveyed for a plan on a scale of 1:400,000.

An exact preliminary plan of Lake Nahuel-Huapi presents an outline very different from that hitherto drawn on the maps.

The Fta-Leufú is identified with the River Frio, the Valley of the Diez y Seis de Octubre has been surveyed and the Carreuleufú is traced to its source in Lake General Paz, its hills and low lands.

The plains in which rise the affluents of the Rio Claro were carefully studied. It is in these plains that the interoceanic division of the waters occurs, at the distance of a hundred kilometres, at least, to the eastward of the Cordillera of the Andes.

Lakes Fontana and La Plata were explored to the mountain chain which bounds them in the neighborhood of the Pacific.

Not the least important work of the expedition was to find the best possible routes of communication between the Andes and the Atlantic. These were found to be two: one leading from Puerto San Antonio on the north side of the Gulf of San Matias to Valdivia, on the Chilian coast; the other from Tilly Road, on the Gulf of St. George, to Lakes Buenos Aires and Fontana, and northward through the Valley of the Diez y Seis de Octubre to Lake Nahuel-Huapi.

This interesting paper is illustrated by a large folding map and 42 plates.

Drs. Wehrli and Burckhardt contribute to the same volume their Preliminary Report on a geological expedition, in 1897, to the portion of the Andine Cordillera comprised between the parallels of 33° and 36° S. Latitude.

A paper entitled *Guayaquis y Anamitas*, by Dr. F. Lahille, is very

pleasant reading. Dr. Lahille gives the floor to his friend Gen. Frey, who traces the origin of the Guayaquis to the Annamites by the following easy steps in etymology:

> The root *ga*, *gua*, *go*, etc., which seems to exist in the French word *gens*, is also found in Annamite in the word *guoye* or *nguoye*, which means *man*, *he*, *she*. *Ya*, in Annamite as in Breton and in German, and *yes* in English, means: *I understand*, *I have comprehended*, *yes*. *Gua-ya* then, is the people who are in the habit of pronouncing the word *ya*, of saying, *yes*, *I have comprehended*.

This kind of learning is displayed through two pages, and Dr. Lahille cannot refrain from expressing his surprise that Gen. Frey has overlooked the obvious relation between the Guayaqui word *rupia* (wife, daughter) and the Sanskrit word *rupa* (cattle); after which he makes the unkind remark that

> Everybody knows in what exaggerations and crazy fancies certain etymologists too often allow themselves to indulge.

*Discussione delle Osservazioni Astronomiche Fatte dal Tenente di Vascello Lamberto Vannutelli, ad detto alla Seconda Spedizione Bòttego in Africa. Nota del Prof. Elia Millosevich, Astronomo del R. Osservatorio del Collegio Romano* (*from the Memorie della Società Geografica Italiana, Vol. VIII, 1898*).

This pamphlet contains Prof. Millosevich's calculation and reduction of all the astronomical observations made by Lieut. Vannutelli, one of the few survivors of the unfortunate Bòttego expedition, massacred near Gobò on the 17th March, 1897.

The observations were taken with a sextant (Troughton and Simms) and were generally double altitudes of stars and distances of the moon from the sun and from the usual stars and planets.

The latitudes of many places were determined by meridian observations and in some cases also by circummeridian observations of stars. The longitudes taken were fewer and less satisfactory, all deduced from lunar distances, the only available method under the conditions of travel, which made the transport of a chronometer a hopeless task. A telescope, for instance, to observe the eclipses of the satellites of Jupiter, would infallibly have been broken, sooner or later, a fate which overtook all the delicate instruments of the party, including even the pocket watches. Only the sextant escaped.

Prof. Millosevich gives the following list of latitudes and longitudes:

132 latitudes calculated, 79 latitudes of places determined.

63 longitudes calculated, 14 longitudes determined.

6 approximate determinations of magnetic declination.

*Geographical Notes, from the T'oung-Pao, Vol. IX, No. 3. By G. Schlegel.*

These Notes continue the series of monographs on Chinese geographical questions, intended by Prof. Schlegel to serve as materials for a complete treatise on ancient Chinese geography.

Note I is on the Nicobar and Andaman islands; Note II on Lang-ga-siu (Tantalam in the Malay Peninsula) and Ceylon.

In the Chinese records the Nicobar islands are known as the *Demons Who Devour Men*, from the belief that the inhabitants were cannibals. The people of the islands are described as very ugly, with red hair, black bodies, teeth like those of beasts and hawk-like claws.

Prof. Schlegel identifies the Hat Island (*Mo-shan*) of the Chinese with the middle island of the group, on Sombrero Channel.

The Andaman islanders go naked, and the Chinese tradition is that when Sakya Buddha passed the islands he stopped to bathe and his robe was stolen. To punish the people, Buddha swore that if they wore clothes thereafter their flesh should decay. It does not break the force of the tradition to remember that Buddha never saw the Andaman islands.

*Orizaba and Popocatepetl.*

Messrs. W. A. Cogshall and A. E. Douglass send a reprint of their papers in *Appalachia*, Vol. VIII, No. 4, 1898, on the ascent of Orizaba and Popocatepetl. Mr. Cogshall's ascent was made in April, 1897, without serious incident other than the feat performed by a Mexican guide, who went back to get coloured glasses for the party. He started at two o'clock in the afternoon, got the glasses, and overtook the party at four o'clock the next morning; a journey of fully thirty miles on foot, with a descent of 3,000 feet and an ascent of 5,000.

Mr. Douglass tabulates and compares various measurements of the mountains and obtains the following result:

| | |
|---|---|
| Popocatepetl... | 17,660 ± 50 feet, or 5384 ± 15 metres. |
| Orizaba........ | 18,240 ± 160 feet, or 5560 ± 50 metres. |

Mr. Douglass's experience of high-mountain climbing is summed up in a second paper.

He finds that if nausea occurs at night it will be relieved when day comes, but if it occurs by day, the climber should turn back at once. There is this unexplained difference between night and day. An abnormally high pulse at night is not serious, unless sleep is

prevented; for with the loss of sleep exhaustion ensues and further climbing may be stopped.

The headache seems to be inevitable at a high elevation, and it generally persists for some time after return to a lower level.

In most cases of hemorrhage there is time for descent to a lower altitude, and this gives relief.

When scientific work is to be done at a great elevation, Mr. Douglass recommends Mr. Whymper's plan of remaining two or three days at a height of about 16,000 feet before beginning work.

The food should be of the kind most easily digested, beef tea, broths, etc. Bread without butter, toasted before an open fire, and water as hot as one can drink it, give tone to the stomach. Alcoholic stimulants may occasionally be of use, but generally they are to be avoided.

*Au Pays des Ba-Rotsi Haut-Zambèze, Voyage d'Exploration en Afrique et Retour par les Chutes Victoria, le Matabéléland, le Transvaal, Natal, le Cap. Ouvrage Illustré de 105 Gravures et de Deux Cartes. Alfred Bertrand, Membre de la Société de Géographie de Genève, Membre de la Société Royale de Géographie de Londres, Membre de la Société de Géographie de Paris. 8°. Paris, Librairie Hachette et Cie., 79 Boulevard Saint-Germain. 1898.*

M. Bertrand was one of four Europeans engaged in the expedition described in his book; the others being Capt. A. Saint-Hill Gibbons, at the head of the party, Mr. Percy C. Reid and Mr. F. D. Pirie. The book is in three parts: the Diary, of nearly 300 pages, and two Appendices, one of 15, the other of 10 pages.

The Diary begins with the start from Southampton, March 23, 1895, and closes with the return to the same port, March 2, 1896.

Interested in everything that came before his eyes, M. Bertrand records his impressions briefly and simply, without any attempt at fine writing. He made the journey from Cape Town to the Zambezi and back again without seeking adventure, but taking it as it came, in the march through the wooded country or the great "thirst land." Writing of his personal experiences, he keeps himself in the background and has nothing to say of his own exploits. Others of the party killed lions; M. Bertrand passed a night in a tree, waiting to shoot a lion that never came.

Of the native kings with whom he spoke Khama was the most remarkable; a monarch who has had the intelligence to forbid traffic in spirituous liquors in his dominions. He is a convert to

Christianity and to the European costume; it is a pity that his tailor is not an artist.

M. Bertrand thinks highly of the work done by the Swiss missionaries among the Ba-Rotsi, evidently not because they are Swiss, but because they are faithful and intelligent men striving to do all the good in their power.

It is not easy, M. Bertrand thinks, to make a comparison between the Victoria Falls of the Zambezi and Niagara, which is perhaps the more imposing from the volume of water, though the African falls are decidedly more picturesque, and their volume must be greatly increased in the rainy season.

The first Appendix gives a summary account of the Ba-Rotsi, their tribes, religion, manners and customs, and the resources of their country, which is bounded, roughly speaking, by the 12th and 18th degrees of south latitude and the 20th and 29th degrees of east longitude.

M. Louis Jalla, a missionary established at Kazungula, communicated the results of 10 years' observations of temperature, as follows:

Mean for the Hot Season (end of October):

Day, 39°–40° Cent. (102°–104° Fahr.).
Night, 20°–22° Cent. (68°–72° Fahr.).

Mean for the Cold Season (May, June, July):

Day, 24°–25° Cent. (75°–77° Fahr.).
Night, 6°–10° Cent. (43°–50° Fahr.).

The climate is generally unhealthy, but the natives are well developed physically, industrious, intelligent, skilful workers in iron and wood, excellent boatmen and stout marchers. They have a gift for mechanics.

One of the missionaries, M. Coillard, affirms that the religious sentiment is more highly developed in the Zambezi people than in any other tribe of South Central Africa. They have neither idol nor fetish; they pay homage to the shades of their ancestors and worship also a supreme being (Nyambé), symbolized by the sun, and his wife, typified by the moon. These two produced, first the animals, and afterwards man. A conflict followed between man and Nyambé, and man was so intelligent that Nyambé took fright and climbed into heaven by a spider's web. He has since remained invisible.

Some of the tribes believe in metempsychosis and each man chooses the animal into which his soul shall pass after death.

The Ba-Rotsi cultivate sorghum, maize, millet, pea-nuts, sweet potatoes, mainoc, squashes, watermelons and tobacco, and they raise cattle of two breeds, goats, sheep and poultry.

The second Appendix condenses the reports of the expedition publishéd in the *Geographical Journal* for February, 1897.

M. Bertrand's figures are generally correct, but he, or his printer, has gone wrong on page 280, in giving to the colony of Natal an area of 32,000 square kilometres,

—equal to the united area of England and Wales.

Natal contains about 50,000 square kilometres; England has 151,048.

Most of the illustrations in this very handsome volume are from photographs by the author.

## ACCESSIONS TO THE LIBRARY.

### July–October, 1898.

BY PURCHASE.

Louis Agassiz: His Life and Correspondence, edited by Elizabeth Cary Agassiz, Boston, 1886, 2 vols., 8vo; The Jesuit Relations and Allied Documents, edited by Reuben Gold Thwaites, Vols. XXI to XXVIII, Cleveland, 1898, 8vo; The United States, by Henry Gannett (Stanford's Compendium of Geography and Travel, North America, Vol. II), London, 1898, 8vo; Bibliographie Brésilienne, par A. L. Garraux, Paris, 1898, 8vo; The Annual Cyclopædia, 1897, New York, 1898, 8vo; Au Cap Nord: Itinéraires en Norvège, Suède, Finlande, par Charles Rabot, Paris, 1898, 16mo; The Cliff-Dwellers of the Mesa Verde, Southwestern Colorado, by G. Nordenskiöld, Stockholm (1893), folio; Dictionary of National Biography, edited by Sidney Lee, Vols. LV and LVI, London, 1898, 8vo; Compte-Rendu, Congrès International Colonial, XIV Section, Bruxelles, 1898, 8vo; Douze Ans en Abyssinie, par Paul de Lauribar, Paris, 1898, 12mo; Vers le Nil Français avec la Mission Marchand, par Ch. Castellani, Paris (1898), 8vo; The Records of New Amsterdam from 1653 to 1674, edited by Berthold Fernow, New York, 1897, 7 vols., 8vo; The Virginia Magazine of History and Biography, edited by Philip A. Bruce, Vols. I–V, Richmond, 1894–1898, 8vo; Reports of the Commission to locate the Site of the Frontier Forts of Pennsylvania (Harrisburg), 1896, 2 vols., 8vo; Neuer Handatlas, von E. Debes, Leipzig, 1895, folio; Aux Fjords de Norvège et aux Forêts de Suède, par Charles Rabot, Paris, 1898, 16mo; Kaart van Noord-Celebes (with pamphlet) door H. Ph. Th. Witkamp, Amsterdam, 1898, sheet, in case; Le Japon Vrai, par Félix Martin, Paris, 1898, 12mo; Leçons de Géographie Physique, par A. de Lapparent, 2me Édition, Paris, 1898, 8vo; Forma Urbis Romæ, Rodulphus Lanciani, Fasc. VI, Mediolani, 1898, folio; The Oxyrhynchus Papyri, Part 1, by B. P. Grenfell and Arthur S. Hunt (Græco-Roman Branch, Egypt Exploration Fund), London, 1898, 8vo; The Traveller's Guide, by Jedediah Morse and R. C. Morse, New Haven, 1823, 16mo; New English and Italian Dictionary, by John Millhouse, 5th edition, New York, 1886, 2 vols., 8vo; Five Years in Damascus, by J. L. Porter, 2d edition, London, 1870, 8vo; Florida: its Scenery, Climate and History, by Sidney Lanier, Philadelphia, 1876, 12mo; A Century of Dishonor, U. S. Government's Dealings with some of the Indian Tribes, by H. H. (Helen Hunt Jackson), New York, 1881, 12mo; Two Campaigns: Madagascar and Ashantee, by Bennet Burleigh, London, 1896, 8vo; Abel Janszoon Tasman's Journal: Van Diemens Land and New Zealand, by J. E. Heeres and W. Van Bemmelen, Amsterdam, 1898, folio; The Natives of Sarawak and British North Borneo, by Henry Ling Roth, London, 1896, 2 vols., 8vo; A Servant of "John Company," Recollections of an Indian Official, by H. G. Keene, London, 1897, 8vo; The Heart and Songs of the Spanish Sierras, by Geo. Whit White, London, 1894, 8vo; Australia Twice Traversed, by Ernest Giles, London, 1889, 2 vols., 8vo; Rambles in the Black Forest, by Henry W. Wolff, London, 1890, 8vo; Twenty-five Years in British Guiana, by Henry Kirke, London, 1898, 8vo; In an Enchanted Island, by W. H. Mallock, London, 1889, 8vo; Too Late for Gordon and Khartoum, by Alex. Macdonald, London, 1887, 8vo; Through

South Africa, by Henry M. Stanley, London, 1898, 8vo; Roughing it in Siberia, by Robert L. Jefferson, London, 1897, 8vo; Cardinal Lavigerie and the African Slave-Trade, by Richard F. Clarke, S.J., London, 1889, 8vo; A Year in Brazil, by Hastings Charles Dent, London, 1886, 8vo; South African Sketches, by A. B. Ellis, London, 1887, 8vo; History of the Gold Coast of West Africa, by A. B. Ellis, London, 1893, 8vo; Blackbirding in the South Pacific, by W. B. Churchward, London, 1888, 8vo; The Outgoing Turk, by H. C. Thomson, London, 1897, 8vo; The Chitral Campaign, by H. C. Thomson, London, 1895, 8vo; Letters from Majorca, by Chas. W. Wood, London, 1888, 8vo; The Life of the Right Honourable Stratford Canning, etc., by Stanley Lane-Poole, London, 1888, 2 vols., 8vo; On Snow-shoes to the Barren Grounds, by Caspar Whitney, London, 1896, 8vo; Through the Subarctic Forest, by Warburton Pike, London, 1896, 8vo; Days Spent on a Doge's Farm, by Margaret Symonds, London, 1893, 8vo; Sir Richard Church in Italy and Greece, by E. M. Church, Edinburgh and London, 1895, 8vo; Man-Hunting in the Desert: Palmer Search-Expedition, by Alfred E. Haynes, London, 1894, 8vo; In New South Africa, by H. Lincoln Tangye, London, 1896, 8vo; A Month in a Dandi: a Woman's Wanderings in Northern India, by Christina S. Bremner, London (1891), 8vo; In the Land of the Bora, or Camp Life and Sport in Dalmatia and the Herzegovina, by "Snaffle," London, 1897, 8vo; A Visit to Java, by W. Basil Worsfold, London, 1893, 8vo; South Africa, by W. Basil Worsfold, London, 1895, 8vo; Exploration and Hunting in Central Africa, by A. St. H. Gibbons, London, 1898, 8vo; The Benin Massacre, by Alan Boisragon, London, 1897, 8vo; Benin, the City of Blood, by R. H. Bacon, London, 1897, 8vo; Glimpses of Italian Society, by Mrs. Piozzi, London, 1892, 8vo; Through the Dolomites, by Alexander Robertson, London, 1896, 8vo; Gold, Sport and Coffee-Planting in Mysore, by Robert H. Elliot, Westminster, 1894, 8vo; Travels in Unknown Austria, by Princess Mary of Thurn and Taxis, London, 1896, 4to; The Real Chinaman, by Chester Holcombe, London, 1895, 8vo; The Thackerays in India, by Sir W. W. Hunter, London, 1897, sq. 8vo; Joseph Thomson, African Explorer, by J. B. Thomson, London, 1896, 8vo; Pioneer Work in the Alps of New Zealand, by Arthur P. Harper, London, 1896, 8vo; On the Indian Hills, or Coffee-Planting in Southern India, by Edwin Lester Arnold, London, 1893, 8vo; Under the Dragon Throne, by L. T. Meade and R. K. Douglas, London (1897), 8vo; Far Cathay and Farther India, by Gen. A. Ruxton Mac Mahon, London, 1893, 8vo; Among the Pagodas and Fair Ladies, by Gwendolen French Gascoigne, London, 1896, 8vo; A Tour through the Famine Districts of India, by F. H. S. Merewether, London, 1898, 8vo; Life of Brian Houghton Hodgson, by Sir W. W. Hunter, London, 1896, 8vo; Untrodden Paths in Roumania, by Mrs. Walker, London, 1888, 8vo; Over the Andes: Argentine to Chili and Peru, by May Crommelin, London, 1896, 8vo; Climbing Reminiscences of the Dolomites, by Leone Sinigaglia, London, 1896, 8vo; A Summer in Kieff, by Isabel Morris, London (1891), 8vo; Seas and Lands, by Sir Edwin Arnold, London, 1891, 8vo; Woman in India, by Mary Frances Billington, London, 1895, 8vo; Jerusalem, the City of Herod and Saladin, by Walter Besant and E. H. Palmer, London, 1871, 8vo; Frontier Lands of the Christian and the Turk, by (James Henry Skene), London, 1853, 2 vols., 8vo; The Holy Roman Empire, by James Bryce, 3d edition, London, 1871, 8vo.

GIFTS.

*From Joseph Britton, San Francisco:*

Charter for the City and County of San Francisco, San Francisco, 1898, 8vo.

*From W. A. Cogshall and A. E. Douglass, Authors:*

A Trip to the Summit of Orizaba, by W. A. Cogshall; The Altitudes of Orizaba

and Popocatepetl, Effects of High-mountain Climbing, by A. E. Douglass, p., 8vo (*reprint*).

*From Levi Holbrook :*

The Financial and Commercial Chronicle, Vols. LXII and LXIII, New York, 1896, folio.

*From Elia Millosevich, Author :*

Discussione delle Osservazioni Astronomiche fatte dal Tenente di Vascello Lamberto Vannutelli, Roma, 1898, p., 8vo. (*reprint*).

*From M. Niemeyer, Publisher, Halle :*

Die Reste der Germanen am Schwarzen Meere, von Richard Loewe, Halle, 1898, 8vo.

*From the N. Y. Produce Exchange, New York :*

Annual Report, 1897–98, New York, 1898, 8vo.

*From Miss Luella Agnes Owen, Author :*

Cave Regions of the Ozarks and Black Hills, by Luella Agnes Owen, *Membre titulaire de la Société de Spéléologie, and Fellow of the American Geographical Society.* Cincinnati, The Editor Publishing Co., 1898.

*From Mrs. C. F. Palmer :*

Inebriety, its Source, Prevention and Cure, by Charles Follen Palmer, New York, 1898, 12mo.

*From P. Lee Phillips, Author :*

Alaska and the Northwest part of North America 1588–1898: Maps in the Library of Congress, Washington, 1898, pr., 8vo.

*From E. L. Plumb :*

A Description of the Mexican Cotton Estates of Tlahualilo, by C. P. Mac Kie, New York, 1897, p., 8vo. (*reprint*).

*From G. Schlegel, Author :*

Geographical Notes : Nicobar and Andaman Islands, Lang-ga-siu, Ceylan.—Leyden, 1898, pr., 8vo. (*reprint*).

*From the Southern Railway Company, Washington :*

The Southland, by Frank Presbrey, Washington (1898), 4to.

## NOTES AND NEWS.

Letters received from Mr. Peary, under date of August 13, state that the season was unusually late, with abundance of ice around Cape York. The Eskimos had deserted their village, as he believed, on account of the heavy ice, in order to look elsewhere for seals.

Mr. Peary wrote from Etah, near the entrance to Smith Sound, and was about to push on in the *Windward* to his winter quarters in North-West Greenland. He had with him ten Eskimos and sixty dogs, with an ample supply of walrus meat for dog food. He had more volunteers than he could accept, and the death of their four tribesmen in New York made no difference in his relations with the Arctic Highlanders. Nothing had been seen of the *Fram*.

A telegram from St. John's, N. F., of October 18 reports that Captain William Bartlett, brother of Captain John Bartlett, commander of the *Windward*, has arrived from a summer's fishing at Turnavick, Labrador, where Captain John Bartlett intended calling for him on the *Windward's* homeward trip from Greenland.

Captain Bartlett declares that he never knew the ice to form more rapidly and heavily than while on his way here, and he has almost abandoned hope that the *Windward* will escape from Arctic regions this autumn.

The Allahabad *Pioneer* records the arrival in India of Mr. Cobbold, from an exploring trip in southern Siberia. He says that near Lake Balkash, where the thermometer occasionally registered thirty degrees below zero, he found a great number of long-haired tigers, which feed upon herds of wild hogs that frequent the jungle around the lake. Mr. Cobbold crossed the Alan Tau mountain range in the Russian Pamirs. He obtained many specimens of gold, silver, copper and iron. This range is inexhaustibly rich in minerals. Central Asia, a hundred years hence, will, he thinks, be the richest mining country in the world.

Col. George Earl Church, who was chosen President of the Geographical Section, at the Bristol meeting of the British Association in September, addressed the Section on *Argentine Geography and the Ancient Pampean Sea.*

His address, which fills thirteen closely-printed pages, gives the results of more than forty years' study and personal observation as a surveyor and explorer in the vast region of the La Plata basin.

The ancient Sea extended from 10° 44′ S. Lat. to the Atlantic, between Uruguay and the Tandil Sierra:

It was probably about 1,400 miles in length, with an average width of above 400 miles. Roughly estimated, its area must have been about 600,000 square miles—say about two-thirds the size of the Mediterranean Sea.

The area of the ancient Mojos Lake (in the north) was about 115,000 square miles, being seven-tenths that of the Black Sea, and exceeding that of the five "Great Lakes" of North America, which is 93,581 square miles. The relation of the Pampean Sea to the Mojos Lake was similar to that of the Mediterranean Sea to the Black Sea.

Traces of it are still observable, notably the great, low, flooded morass of Xarayas on the Upper Paraguay River, and the ancient delta of the Paraná, including the Ybará lagoon. The Salina Grande was also an arm of it—a great inland fiord. The sea, moreover, must have covered large areas of Paraguay, Corrientes, Entre Rios, and Uruguay, and, before the uplifting of the country, it extended south-west to the rivers Chadi-Leofu and the Colorado, lapping round the southern slope of the Ventana range until the curved rim, concave to the north-east, which connects this with the Sierra de Cordova, was sufficiently elevated to completely cut off its south-western extension. This rim, for the first fifty miles, starting at the Ventana, is about 700 to 750 feet above the sea, and shows much *tosca** rock near the surface. It afterwards rises rapidly towards the Cordova sierra.

The bed of this great sea was apparently raised to its present level by a slow, general upheaval of the Andes from west to east.

Col. Church is inclined to believe that the cubic volume of the stream which poured into the Pampean Sea was equal to twice that which the Mississippi now sends into the Gulf of Mexico, and he estimates the age of the Pampean formation at about 70,000 years.

The *Université Nouvelle*, of Brussels, founded on the 18th of March last a Geographical Institute, which is not bound

to follow a programme dictated by a Higher Council of Public Instruction.

This burdensome obligation being set aside, the *Université Nouvelle* has adopted the following plan of studies:

*Preparatory Course*—

Natural History, Physics, Mathematics, Geography, History and Chronology, Languages—English, German, Russian, Italian, Spanish, Portuguese—Drawing.

*First Year*—

Cosmography, Geography, Mathematical and Physical; Meteorology, Geology, Biology, Languages, Drawing, Photography of Maps, Reliefs.

*Second Year*—

Cosmography and Mathematical Geography, Physical Geography, with Meteorology and Hydrology, Geology and Palæontology, Botanical Geography, Anthropology, Languages, Drawing, Map Construction and Reliefs.

*Third Year*—

Geodesy, Geological Structure of the Globe, Zoological Geography, Anthropology,

* Elsewhere explained as equivalent to *tufa*.

Medical Geography, Ethnography, with Colonisation, History of Geography (Palæography and Portolani), Comparative Geography, Toponymy, Commercial and Statistical Geography, Map Construction, Reliefs, Instruments and Apparatus.

Each year there will be excursions and journeys by land and sea.

The studies will include memoirs, to be published by the Institute. The maps and reliefs will be so constructed that the *Université Nouvelle* may accept them as its own and publish them.

Students entered in the Geographical Institute will pay the University dues, and will bear, in addition, the expense of the excursions. The library and map collections will be open to all the students, who will be asked to contribute for the general use such geographical works as they possess.

The Institute desires to enter into relations of exchange with geographical societies: Address: rue des Minimes 21, Brussels.

The College of Commerce in the University of California.—At the Commencement of the University of California on the 18th of May last the President, Martin Kellogg, among other important matters, announced that the Board of Regents had established the College of Commerce; and that they had secured the services of a distinguished scientist, Prof. George Davidson, for the chair of geography. The College commenced its official life by the act of the Regents when they adopted the clear and comprehensive report of the Special Committee appointed for that purpose.

This brief announcement was supplemented and expanded in the Commencement Address of Prof. Edmund J. James, of the University of Chicago. The title of his address was suggestive, "The University and its Relation to Practical Life." He rapidly sketched the great features and purposes of a university; of the oldest universities; and of universities provided in different countries for the special benefit of those countries at given epochs. In the latter part of his discourse he came to the practical needs and demands of the present day in the United States. He granted the largest culture in the University, but declared for a thorough knowledge of the laws of finance (his own special study), for a proper outfit for men in the management of great modern industrial organizations, for education in diplomatic and consular law and intercourse, and for an equipment in the laws, usages and demands of commerce in its thousand ramifications, etc.

He pointed out that every great producing country was seeking new markets, and struggling for the mastery and control of the countries and commerce of the world. He contended that those who entered upon these and cognate careers were entitled to all

that a university could give just as much as those who studied the humanities, law and medicine.

He showed the prime necessity for a College of Commerce upon the Pacific coast of the United States, where the whole trade of the countries bordering the Pacific, and the islands of the Pacific, lay directly within reach of the ports of the three states of California, Oregon and Washington.

This was the first College of Commerce organized by any university, and he believed it would expand to embrace all subject matters of finance and diplomacy.

The *Société de Géographie de Dunkerque*, hitherto absorbed in the *Union Géographique du Nord*, published in June last the first number of an independent quarterly Bulletin, devoted to the interests of Dunkirk and to commercial and to general geography. A special feature of this new periodical is a *Revue des Ports*, giving statistics of the commerce of Dunkirk and comparative statements of tonnage entered at French, Belgian, German and other ports.

With this useful information the *Bulletin* furnishes also the agreeable in a letter from Pierre Loti, who writes from Madrid to excuse himself for holding back a promised contribution:

So many things have upset my life that, I assure you, I could not do otherwise.

The contribution appears in the *Bulletin* of September 15, with the title: *An Audience of the Sphinx*, in two pages, as effective in their way as Kinglake's in Eöthen.

A communication from the *Sociedad Geográfica de Lima*, under date of August 1, brings tidings of the loss sustained by that active Society in the death of Dr. Luis Carranza, its able and accomplished president for the past eight years.

The Bordeaux *Société de Géographie Commerciale* announces the death, on the 15th of September, of M. Jacques Gebelin, professor in the University of Bordeaux and for the last sixteen years prinpal editor of the Society's *Bulletin.*

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At the meeting of the Society, November 14, 1898, Mr. George Byron Gordon of the Peabody Museum, Cambridge, will give an account of the work of the Museum in the exploration of Copan, Honduras.

On the 12th of December Mr. Cosmos Mindeleff will address the Society on the subject of American Aboriginal Architecture, in the United States.

# HONORARY AND CORRESPONDING MEMBERS AND FELLOWS.

## HONORARY MEMBERS.

DUFFERIN and AVA, the Marquis of.
HARMSWORTH, Alfred Charles, London.
MARKHAM, Sir Clements R., K.C.B., President of the Royal Geographical Society.
MCCLINTOCK, Admiral Sir F. L., R.N., K.C.B.
NANSEN, Dr. Fridtjof, Christiania.
NARES, Rear-Admiral Sir George S., R.N., K.C.B.
NORDENSKIÖLD, Baron A. E., Stockholm.
PEARY, Civil Engineer R. E., U.S.N.

## CORRESPONDING MEMBERS.

ABBE, Prof. Cleveland, Washington.
BONAPARTE, Prince Roland, Paris.
BOWEN, Rt. Hon. Sir George Ferguson, G.C.M.G., London.
BREWER, Prof. Wm. H., New Haven.
BROWNLEE, Harrison J., C.E., Vancouver.
CHAIX, Prof. Paul, Geneva, Switzerland.
CHAIX, Prof. Emile, Geneva, Switzerland.
COELLO y QUESADA, Don F., President of the Madrid Geographical Society.
CORA, Prof. Guido, Rome.
DAVIDSON, Prof. Geo., San Francisco.
DU CHAILLU, Paul B.
FISKE, Prof. John, Cambridge, Mass.
GANNETT, Henry, Washington, D. C.
GARDNER, Prof. James T., Albany.
GILLIODTS VAN SEVEREN, L., LL.D., Bruges.
GILMAN, Daniel C., LL.D., President Johns Hopkins University, Baltimore.
GOBAT, Dr. A., Nat. Councillor, Berne.
GRIGORIEV, Alex. V., Sec'y Imp. Russian Geographical Society, St. Petersburg.
JACKSON, Frederick George, London.
LAPPARENT, Prof. A. de, Paris.
LECLERCQ, Jules, Brussels.
LONG, Col. C. Chaillé.
LUCE, Rear-Admiral S. B., U.S.N.
LUMHOLTZ, Carl, M.A., Christiania, Norway.
MAUNOIR, Charles, Paris.
MCCARTEE, D. Bethune, M.D., New York.
NEY, Count Napoléon, Paris.
PACKARD, Prof. A. S., Providence, R. I.
PEET, Rev. S. D., Chicago, Ill.
PERALTA, Manuel M. de, Liege.
PROUT, Henry G.
PUMPELLY, Prof. Raphael.
ROMERO, Matias, Envoy of Mexico at Washington.
SEMENOV, Peter P., Vice-Prest. Imp. Russ. Geog. Soc., St. Petersburg.
STANLEY, Henry M.
TACHÉ, E. E., Asst. Commissioner of Crown Lands, Quebec.
VINCENT, Frank, New York.
VON DEN STEINEN, Prof. Dr. Karl, Berlin.
WHITEHOUSE, Cope.
WRIGHT, Gen. Horatio G., U.S.A., Washington.
WYSE, Lieut.-Com. Lucien N. B., Paris.

## FELLOWS.

### OCTOBER 31, 1898.

*Names of Life Fellows are printed in italics.*

Date of Election.

1874 *Avery, Samuel P.*
1874 *Agnew, John T.*
1874 *Amy, Henry.*
1874 *Astor, Hon. W. W.*
1881 *Armour, Herman O.*
1883 *Atterbury, J. T.*
1887 *Archbold, John D.*
1889 *Abbot, Edwin H., Boston.*
1890 *Anderson, Arthur A.*
1871 Atterbury, Rev. Wm. W., D.D.
1872 Allen, Horatio M., S. Orange, N. J.
1875 Amsinck, Gustav.
1876 Appleton, Nathan, Boston.
1879 Agostini, Joseph.
1883 Ames, Adelbert, Highlands, N. J.
1883 Aub, Albert.
1885 Agnew, Andrew G.
1885 Adams, C. H.
1886 Appleton, Wm. H.
1886 Agassiz, Prof. Alex., Cambridge, Mass.
1886 Alden, R. Percy.
1887 Andrews, Wm. L.
1888 Alexander, J. F.
1890 Andreini, J. M.
1890 Astor, John J.
1891 Arms, Geo.
1891 Agar, John G.
1891 Atkinson, John B., Earlington, Ky.
1891 Armstrong, Collin.
1892 Adams, Cyrus C.
1895 Arnot, M. H.
1895 Alling, Asa A.
1896 Ames, Caleb T.
1897 Anderson, A. J. C.
1897 Avery, Frank Montgomery.
1897 Ayer, James C., M.D.
1898 Aldrich, Mrs. James Herman.

1859 *Boorman, J. Marcus, Brooklyn.*
1868 *Bqnks, David.*
1869 *Bierstadt, Albert.*
1874 *Bishop, D. W.*

Date of Election.

1874 *Backus, Henry C.*
1874 *Baldwin, Townsend B., Edgewater Park, N. J.*
1874 *Brownson, Commander W. H., U. S. N.*
1877 *Bixby, Robert F.*
1878 *Bliss, Hon. Cornelius N.*
1878 *Barton, Oliver Grant.*
1880 *Banks, D. S.*
1881 *Baldwin, Edwin.*
1882 *Bacon, Francis M.*
1882 *Barger, Samuel F.*
1883 *Bowne, Walter.*
1884 *Bonner, G. T.*
1886 *Barker, P. C., M.D., Morristown, N. J.*
1886 *Brown, Hon. Addison.*
1887 *Brown, Robert I.*
1887 *Biglow, Lucius H.*
1887 *Barbey, Henry I.*
1887 *Barron, John C., M.D., Tarrytown.*
1888 *Bancroft, H. H., San Francisco, Cal.*
1889 *Bigelow, Poultney.*
1890 *Bliss, D. L., Carson City, Nevada.*
1890 *Boyd, John Scott.*
1890 *Brackenridge, G. W., San Antonio, Texas.*
1897 *Bailey, Miss Alletta Nathalie.*
1897 *Brainard, Lieut.-Col. David L., U. S. A.*
1868 Bennett, James Gordon.
1868 Bernheimer, Simon.
1869 Banyer, Goldsboro.
1869 Bickmore, Prof. A. S.
1874 Bien, Julius.
1874 Bissinger, Philip.
1874 Barnes, John S.
1874 Bonner, Robert.
1874 Butler, William Allen.
1874 Barr, William.
1874 Belding, Milo M.
1874 Bookstaver, Hon. Henry W.

Date of Election.
1875 Beaman, Charles C.
1875 Beekman, Gerard.
1875 Brownell, Silas B.
1875 Beste, Henry.
1878 Brówn, Rev. Philip A. H.
1878 Brown, J. Romaine.
1881 Babcock, Samuel D.
1882 Baldwin, Octavius D.
1882 Barney, Newcomb C.
1883 Baker, Cyrus O.
1883 Banta, Theodore M.
1883 Bergen, Tunis G.
1883 Bennett, Ludovic.
1883 Blake, Frederick D.
1883 Bell, Capt. W. R.
1883 Benson, Frank Sherman.
1884 Bangs, Fletcher H.
1884 Brookfield, William.
1885 Bliss, George T.
1886 Bridgman, E. C.
1886 Bowers, John M.
1886 Backus, J. Bayard.
1886 Bouvier, M. C.
1886 Beddall, Edward F.
1886 Berwind, Edward J.
1886 Bond, Frank S.
1887 Blagden, George.
1887 Berrian, Charles M.
1887 Bend, George H.
1888 Bogert, S. G.
1888 Bruce, Sanders D.
1888 Burgess, Prof. John W.
1888 Bacon, Lathrop R.
1888 Beers, M. H.
1888 Barstow, J. Whitney, M.D., Flushing, N. Y.
1889 Bromberg, Fredk. G., Mobile, Ala.
1889 Biddle, Edward R.
1889 Baring, Thos.
1889 Brown, Wm. Reynolds.
1889 Bleything, Geo. Dacre, M.D.
1890 Benedict, Jas. H.
1890 Barnard, Jno. F., Council Bluffs.
1890 Brooker, Chas. F., Torrington, Conn.
1890 Bertschmann, J., Swiss Consul.
1890 Bushnell, Jos.
1890 Bergen, Jas. C.
1890 Brewster, C. O.
1891 Bernheim, Gustav.

Date of Election.
1891 Babcock, Stephen E., Little Falls, N. Y.
1891 Belin, Henry, Jr., Scranton, Pa.
1891 Boies, H. M., Scranton, Pa.
1891 Barber, Amzi L.
1891 Besly, Chas. Howard, Chicago.
1891 Brice, Hon. Calvin S.
1891 Bogue, Virgil G., Chicago.
1891 Bell, Ed. W.
1891 Blanchard, Jas. A.
1892 Brandreth, Wm.
1893 Birdsall, Mrs. W. R.
1893 Brigham, Edward Morris, Battle Creek, Mich.
1894 Baiz, Jacobo.
1895 Bradley, Edson.
1895 Boas, Emil L.
1895 Bien, Joseph R.
1895 Butler, Joseph G., Jr.
1895 Beal, Wm. R.
1896 Burgess, Thos. F.
1897 Biddle, Anthony J. Drexel, Philadelphia.
1897 Biederbick, Henry, Hoboken, N. J.
1897 Bell, Dr. Ralcy H., Atlanta, Ga.
1897 Belding, Milo M., Jr.
1897 Bunker, Matthew.
1897 Booth-Tucker, Fred. de L.
1897 Bacon, Selden.
1897 Ballin, Jacques.
1897 Billings, Dr. J. S.
1897 Brooks, Geo. G.
1897 Billings, Frederick.
1897 Burdge, Franklin.
1897 Benjamin, Morris W.
1897 Bradley, Chas. W.
1897 Blodgett, Mrs. Wm. T.
1898 Blake, Theodore A., New Haven.
1898 Brydges, Rev. Ralph L., Islip, N. Y.
1898 Beer, William, New Orleans.
1898 Burr, Prof. Wm. H.
1898 Batchelor, Charles.
1898 Barnes, Chas. J., Chicago.

1874 *Church, Col. George E., London.*
1874 *Conyngham, Wm. L.*
1875 *Cameron, Sir Roderick W.*
1879 *Coddington, Gilbert S.*
1881 *Clinton, Henry L.*

Date of Election.
1882 *Clarkson, Banyer.*
1883 *Chapman, Henry E.*
1884 *Claflin, John.*
1884 *Connor, W. E.*
1886 *Colvin, Verplanck, Albany, N Y.*
1886 *Carter, Henry C.*
1886 *Chauncey, Elihu.*
1887 *Cranitch, William I. A.*
1888 *Coutan, Adolphe R.*
1888 *Coutan, Charles Albert.*
1888 *Cochran, William F.*
1889 *Coxe, Henry B.*
1889 *Carter, John J., Titusville, Pa.*
1897 *Comstock, Frederick H.*
1897 *Chapin, Chester W.*
1856 Cooper, Hon. Edward.
1868 Chapman, Joseph H.
1874 Constable, James M.
1874 Crosby, Hon. J. Schuyler.
1874 Colgate, James B.
1874 Constantine, Andrew J.
1874 Crocker, Geo. A.
1876 Curtis, Benj. L.
1882 Coudert, F. R., LL.D.
1882 Conkling, Rev. N. W., D.D.
1883 Clyde, W. P.
1883 Clews, Henry.
1884 Carey, Henry T.
1886 Conger, Clarence R.
1886 Coffin, Edmund.
1886 Church, Benjamin S.
1886 Corthell, E. L., Chicago.
1886 Clarke, Stephen G.
1886 Clarke, C. C.
1886 Calder, George.
1887 Clark, Jefferson.
1887 Cannon, H. W.
1887 Compton, A. T.
1888 Colgate, Abner W.
1888 Crimmins, John D.
1888 Chase, George.
1888 Cook, Henry H.
1888 Canda, Chas. J.
1888 Coleman, James S.
1888 Chrystie, Wm. F.
1888 Chisolm, George E.
1889 Clark, Chas. F.
1889 Crane, Chas. R., Chicago.
1889 Clausen, George C.
1889 Comstock, Geo. Carlton.

Date of Election.
1889 Cole, Eugene M.
1890 Chanler, Wm. Astor.
1890 Carter, A.
1890 Cockcroft, Miss Mary T.
1890 Carnrick, Jno.
1891 Cohen, Sam'l M.
1891 Cogswell, W. B., Syracuse.
1891 Clapp, Geo. H., Pittsburg.
1891 Cook, J. Hervey, Fishkill-on-Hudson.
1891 Cooper, John.
1892 Comer, John H.
1893 Coolidge, J. Randolph, Boston.
1893 Crawford, Francis.
1893 Cummings, Thos. H., Boston.
1894 Cook, F. A., M.D.
1894 Carey, Wm. Francis.
1895 Carter, Walter S.
1897 Chamberlain, Rev. L. T.
1897 Corning, G. M.
1897 Cameron, W. L.
1897 Chambers, Frank R.
1897 Church, Geo. H.
1897 Coffin, C. A.
1897 Chamberlain, Rev. John.
1897 Combe, Mrs. William.
1897 Cassard, Wm. J.
1898 Cook, Eugene B., Hoboken.
1898 Carmalt, Dr. W. H., New Haven.
1898 Cox, A. Beekman, Cherry Valley, N. Y.
1898 Clous, Lieut.-Col. J. W., U. S. A.
1898 Cuttin, Prof. Thos. L., Darlington, S. C.
1898 Curtis, Osborn Marcus.
1898 Cross, F. C., Luling, Tex.

1855 *Daly, Charles P., LL.D.*
1874 *de Peyster, Gen. J. Watts.*
1874 *Dunscombe, Richard T.*
1874 *Du Bois, Wm. A.*
1875 *de Peyster, Frederic J.*
1877 *Davis, Joseph Beale, Orange, N. J.*
1880 *Deane, John H.*
1880 *Dexter, Henry.*
1880 *Deen, William M.*
1881 *Docharty, Augustus T.*
1882 *Dunlap, Robert.*
1884 *Douglas, James.*
1885 *Dupré, Ovide.*

Date of Election.
1886 *de Lancey, Edward F.*
1887 *Doudge, James R.*
1888 *Davenport, Hon. Ira, Bath, N. Y.*
1889 *Donald, Peter.*
1890 *Dinsmore, C. Gray.*
1856 Douglass, Andrew E.
1856 Dodge, Wm. E.
1871 Daly, Hon. Joseph F.
1874 Delafield, M. L.
1874 Dun, R. G.
1875 Davies, Julien T.
1875 Davison, Charles A.
1875 Dommerich, L. F.
1880 Du Bois, Frederick N.
1883 Decker, Jos. S.
1884 Davis, Howland.
1884 Dalley, Henry, Jr.
1886 Dix, Rev. Morgan, D.D.
1887 Dickson, John.
1887 Davenport, W. F., M.D.
1888 Dunham, James H.
1888 Drexel, Mrs. Joseph W.
1889 De Zeller, John R.
1889 Dodd, S. C. T.
1889 Durkee, Eugene W.
1889 Dwight, Jonathan, Jr., M.D.
1889 Dupont, Col. H. A., Wilmington, Del.
1889 Daley, Geo. H.
1889 Deal, W. E. F., Virginia City, Nev.
1889 Dexter, Julius, Cincinnati.
1890 Douglas, O. B., M.D.
1890 Dellinger, Chas. F.
1891 Drey, Max.
1892 Daniels, W. L., Bayonne, N. J.
1892 Draper, Mrs. Henry.
1892 DeBuys, A.
1893 Dodson, Robt. Bowman.
1894 Dieterich, Chas. F.
1894 Duvall, Wm. C.
1894 Dean, C. W.
1895 Daniels, Charles H.
1895 Dessar, Leo C.
1895 De Kalb, Courtenay.
1896 Dodge, Richard E.
1897 Delbridge, Chas. L., Atlanta.
1897 Dillingham, Edwin R.
1897 Doremus, R. Ogden, M.D.
1897 Dodge, Rev. D. Stuart.
1897 Dubourcq, Louis I.

Date of Election.
1897 Doughty, Mrs. Alla.
1897 Dunnell, Rev. Wm. N.
1897 Dunscomb, S. Whitney, Jr.
1898 Davis, J. C. Bancroft, LL.D., Washington.
1898 Dunham, Edward K., M.D.
1898 Davidson, James W., Tamsui, Formosa.

1879 *Elliott, Samuel.*
1882 *Emerson, J. W.*
1882 *Ellis, Wilbur Dixon.*
1882 *Earle, Joseph P.*
1886 *Easton, Robert T. B.*
1859 Evarts, Hon. William M.
1868 Emmet, Thomas Addis, M.D.
1874 Eaton, Prof. D. Cady, New Haven, Conn.
1875 Ellis, John W.
1877 Elderkin, John.
1879 Earle, Ferdinand P.
1880 Eckert, Gen. Thomas T.
1882 Edwards, Hon. J. Pierrepont.
1883 Eno, Amos F.
1886 Ellis, Geo. W.
1887 Elkins, Hon. S. B.
1887 Egleston, Melville.
1891 Eustis, W. E. C., Boston.
1891 Edgerton, E. D., Helena, Mont.
1891 Eyerman, John, Easton, Pa.
1897 Eimer, August.
1897 Ellison, John E.
1898 Emmonds, J. Gordon.

1874 *Fox, Austen G.*
1886 *Flagler, H. M.*
1888 *Ferguson, Walton, Stamford, Conn.*
1889 *Fenton, David W.*
1890 *Fearing, Daniel B., Newport, R. I.*
1897 *Flanigan, William L.*
1898 *Ferguson, Prof. Henry, Hartford, Conn.*
1860 Field, Rev. H. M.
1864 Faile, Thomas H.
1871 Fliess, Wm. M.
1873 Freedman, Hon. John J.
1874 Farragut, Loyall.
1875 Fargo, James C.
1875 Fuller Charles D.

Date of Election.

1875 Ford, James B.
1875 Folsom, George W.
1881 Fearing, William H.
1882 Fairbanks, Leland.
1884 Frazer, Alfred.
1887 Floyd, John Gelston.
1889 Frazar, Everett.
1889 Freeland, Theodore H.
1889 Flint, Chas. R.
1889 Freeman, Wm. C., Cornwall, Pa.
1890 Fellowes, F. Wayland, New Haven, Conn.
1890 Fairchild, Hon. Chas. S.
1890 Farnam, Henry W., New Haven, Conn.
1892 Fairchild, Samuel W.
1894 Frick, John.
1894 Fox, Andrew Jackson, M.D.
1894 Frazer, Horatio N.
1895 Foot, James D.
1896 Fanton, Hull.
1896 Farquhar, Edward Y.
1897 Ferguson, Wm. E.
1897 Fitz Gibbon, Edward.
1898 Fearons, Geo. H,

1868 *Gebhard, William H.*
1868 *Gerry, Elbridge T.*
1874 *Gibbs, Theodore K.*
1879 *Graves, Arthur B.*
1881 *Grace, Hon. William R.*
1883 *Greenough, John.*
1883 *Goodridge, John C., Jr.*
1886 *Gunther, Franklin L.*
1886 *Goodwin, James J.*
1887 *Grosvenor, James B. M.*
1889 *Gage, E. B., Tombstone, Arizona.*
1889 *Gardner, John L., Boston.*
1889 *Gest, Erasmus, Reno, Nev.*
1893 *Gilbert, J. H. Grenville, Ware, Mass.*
1898 *Goodnow, Lieut. Harold P., U.S.A.*
1856 Greenwood, Isaac J.
1868 Green, Andrew H.
1872 Gerard, James W.
1879 Gay, Joseph E.
1881 Gallaway, R. M.
1881 Garland, James A.
1882 Gardiner, J. Grahame.
1885 Glazier, Simon W.

Date of Election.

1885 Gibson, George Rutledge.
1886 Gallatin, Frederic.
1886 Godkin, E. L.
1887 Gould, George J.
1887 Gossler, Gustav H.
1888 Greene, Byron W.
1888 Grafton, Joseph.
1889 Gurnee, Augustus C.
1889 Gilbert, G. K., Washington, D. C.
1891 Greene, David M., Troy, N. Y.
1891 Gay, Edward, Mt. Vernon, N. Y.
1892 Greenwood, Langdon, Jr.
1892 Gutteridge, Rev. John A., Newark, N. J.
1894 Gherardi, Rear Adm. Bancroft, U. S. N.
1894 Gibbs, John Wilson, M.D.
1894 Gould, Linus A.
1895 Greeff, Ernest F.
1897 Gunther, Charles B.
1897 Grossmann, Ignatius R.
1897 Garver, John A.
1897 Gibbs, Fredk. S.
1897 Gleason, John J.
1897 Greene, D.
1897 Gruber, Abraham.
1897 Grosvenor, Rev. Wm. M.
1897 Green, Fredk. V.
1897 Golding, John Noble.
1898 Green, Samuel Swett, Worcester, Mass.
1898 Goodridge, Mrs. Frederic.
1898 Goodwin, Rev. Francis, Hartford, Conn.
1898 Greene, Jacob L., Hartford.

1859 *Havemeyer, John C.*
1868 *Huntington, Daniel.*
1869 *Hadden, John A.*
1872 *Holbrook, Levi.*
1874 *Hinton, John H., M.D.*
1874 *Huntington, C. P.*
1878 *Hitchcock, Hiram.*
1883 *Hebert, Henry B.*
1883 *Hurry, Edmund Abdy.*
1883 *Hoyt, Alfred M.*
1888 *Hoyt, Henry R.*
1889 *Huntington, Charles P.*
1889 *Hurtt, Frank D.*
1889 *Hitchcock, Welcome G.*

Date of Election.
1892 *Hyde, Clarence M.*
1895 *Hutchinson, Charles Hare.*
1897 *Hearn, Geo. A.*
1898 *Hubbard, Robert J.*
1898 *Hearn, Arthur H.*
1856 Hewitt, Hon. Abram S.
1868 Hall, Elial F.
1871 Hand, Clifford A.
1874 Haines, John P.
1874 Hendricks, Edmund.
1874 Hoyt, Harlow M.
1876 Holt, Henry.
1876 Hoes, Wm. M.
1878 Hinman, Wm. K.
1879 Hamilton, Wm. G.
1881 Hinman, Russell.
1882 Hascall, Theodore F.
1882 Higginson, James J.
1883 Hyde, E. Francis.
1885 Hubbard, Walter, Meriden, Ct.
1886 Hoe, Robert.
1886 Henderson, Harold G.
1886 Hoffman, Rev. Eugene A., D.D.
1886 Hitchcock, Bradford W.
1886 Hillhouse, Thomas G.
1887 Hinchman, Walter.
1887 Hastings, Prof. Thomas S., D.D.
1887 Hague, James D.
1887 Hunker, Lieut. J. J., U. S. N.
1887 Hayes, Richard Somers.
1887 Hill, James J.
1887 Hoadley, Hon. George.
1888 Hard, Anson W.
1888 Hathaway, Horatio, New Bedford, Mass.
1888 Hayward, James W.
1888 Harbeck, Chas. T., Islip, N. Y.
1889 Haynes, Prof. Henry W., Boston.
1889 Hastings, W., Wilmington, Del.
1889 Harper, Orlando M.
1889 Hallidie, A. S., San Francisco.
1889 Hayward, John H.
1889 Harrower, H. D.
1889 Howells, Henry C.
1889 Henley, Wm. I.
1890 Hill, James K., St. Paul, Minn.
1890 Husted, Seymour L., Jr.
1891 Henderson, Joseph J., Kingsbridge, N. Y.
1891 Haas, Kalman.

Date of Election.
1891 Herrman, A.
1891 Hazard, Fred'k R., Syracuse.
1893 Holden, E. F., Syracuse.
1893 Hurlbut, Theo. D.
1893 Hitchcock, Henry, St. Louis.
1893 Holls, Fred'k Wm.
1893 Huntington, Archer M.
1894 Hoyt, Eugene F., M.D.
1894 Haven, J. Woodward.
1894 Hildreth, J. Homer.
1895 Hoyt, Dr. Ezra P.
1896 Hartley, Henry, M.D.
1896 Hotchkiss, Miss C. W.
1896 Hoppin, Hamilton L.
1897 Hagerman, G. E.
1897 Hoppin, Samuel Howland.
1897 Heike, C. R.
1897 Hudson, John E., Boston.
1897 Hendricks, Clifford B.
1897 Humphreys, Alex. C.
1897 Hart, Walter T., Rye, N. Y.
1897 Hoe, Wm. A.
1897 Heinsheimer, L. A.
1897 Huyler, John S.
1897 Hochschild, Berthold.
1897 Hetzel, John J.
1897 Hyde, Dr. Fredk. E.
1897 Hoey, Rev. Jos. L.
1898 Hodgson, Richard, LL.D., Boston.
1898 Hoppin, Prof. James M., D.D., New Haven.
1898 Howell, Maxwell D.
1898 Hoffman, J. W., Orangeburg, S. C.

1881 *Ives, Brayton.*
1887 *Isham, Charles.*
1887 *Ivison, David B.*
1859 Ireland, John B.
1874 Iselin, Adrian, Jr.
1890 Irving, Walter.

1874 *Jesup, Morris K.*
1880 *Jewett, George L.*
1886 *Jackson, Rev. Samuel M.*
1888 *Jones, Oliver L.*
1871 Jones, Walter R. T.
1874 Jenkins, Wm. L.
1874 James, D. Willis.
1874 Jaffray, Robert.
1879 Jay, William.

Date of Election.

1881 Johnson, Bradish.
1885 Juilliard, A. D.
1886 Janeway, Henry L., New Brunswick, N. J.
1886 Jacobi, A., M.D.
1887 Jenkins, Augustus S.
1890 James, Walter B., M.D.
1890 Johnes, Edward R.
1890 Janin, Henry.
1891 Jaques, W. H., South Bethlehem, Pa.
1891 Jones, Washington, Philadelphia.
1891 Jaffray, Robt., Jr.
1893 Johnson, Reverdy, Baltimore.
1893 Jenkins, Michael, Baltimore.
1893 Julien, Alexis A.
1894 James, Arthur Curtiss.
1895 Jennings, Oliver G.
1895 James, Charles F.
1897 Jameson, Prof. Joseph M.
1897 James, Edward C.
1897 Jackson, Theodore F.
1897 Judson, Rev. Edward.

1873 *Kennan, George, Washington, D.C.*
1874 *Kingsland, William M.*
1876 *Knauth, Percival.*
1877 *King, Clarence.*
1878 *Kernochan, Jas. Lorillard.*
1880 *Keene, James R.*
1881 *Kennedy, John S.*
1881 *Kane, Grenville.*
1882 *King, George Gordon, Newport, R. I.*
1885 *Keppler, Rudolph.*
1886 *Kidder, Camillus G.*
1887 *Knight, George T.*
1888 *Kelly, Edward.*
1889 *Kimball, F. J., Philadelphia, Pa.*
1893 *Kane, Henry Brevoort.*
1895 *Kean, Hamilton F.*
1898 *King, Hon. John A.*
1874 King, Edward.
1874 Keck, Thomas.
1879 Kane, S. Nicholson.
1881 Kirsch, Louis.
1883 Kerr, Walter.
1883 King, D. H., Jr.
1886 Kendall, Edward H.
1887 Kevan, William.

Date of Election.

1888 Kissel, Gustav E.
1888 Kellogg, Charles, Athens, Pa.
1888 Kennedy, H. Van Rensselaer.
1889 Kauffmann, S. H., Washington, D. C.
1890 Kempton, C. W., Oro Blanco, Arizona.
1891 Kissel, Rudolph H.
1892 King, John Hurtin.
1897 King, Morris Lee, M.D.
1897 Kemmerer, M. S., Mauch Chunk, Pa.
1897 Kimball, Alfred R.
1897 Kohn, S. H.
1897 Keene, Roswell W.
1897 Kelso, G. Radford.
1897 Keiley, John D.
1898 Kohn, Harry D.

1859 *Lathers, Richard.*
1869 *Lawrence, John S.*
1870 *Loew, Hon. Frederick W.*
1874 *Lorillard, Pierre.*
1875 *Low, Hon. Seth.*
1876 *Low, A. Augustus.*
1878 *Loubat, J. F., LL.D.*
1881 *Libbey, Prof. William, Princeton, N. J.*
1881 *Langdon, Woodbury G.*
1881 *Little, Hon. Joseph J.*
1886 *Ludington, C. H.*
1888 *Lynch, James D.*
1890 *Loth, Joseph.*
1891 *Lansing, Abraham, Albany, N. Y.*
1896 *Lewis, Clarence McK.*
1897 *Livingston, Goodhue.*
1870 Lyman, Edward H. R.
1878 Leon, Néstor Ponce de.
1882 Langdon, Woodbury.
1882 Lapham, Lewis H.
1883 Lounsbery, R. P.
1886 Leete, C. H.
1887 Logan, Walter S.
1887 Lovell, John W.
1889 Lewis, Richard V.
1889 Lovell, Frank H.
1889 Lydig, David.
1889 Lowthian, Thos., Denver, Colo.
1890 Lamberton, Chas. L.
1891 Levine, Julius.

Date of Election.
1891 Loewy, Benno.
1891 Leavitt, E. D., Cambridgeport, Mass.
1891 Lewis, Enoch, Philadelphia.
1892 Lawrence, E. A.
1893 Learned, Hon. Wm. L., Albany.
1895 Landon, Francis G.
1895 Le Boutillier, Thos.
1897 Long, Thos. J.
1897 Lawrence, Cyrus J.
1897 Larrabee, Jesse.
1897 Lobenstine, Wm. C.
1897 Lachman, Samson.
1897 Livermore, Frank, M.D.
1898 Lowenstein, B.
1898 Lamberton, James M., Concord, N. H.
1898 Lincoln, Solomon, Boston.
1898 Lockwood, Homer N.
1898 Ladd, Rev. Horatio Oliver.

1859 *Morrell, William H.*
1859 *Moore, Frank.*
1863 *Moore, W. H. H.*
1864 *Morton, Hon. Levi P.*
1868 *Marquand, Henry G.*
1872 *Marié, Peter.*
1874 *Morris, Henry L.*
1874 *Morgan, J. Pierpont.*
1874 *Merrall, William J.*
1875 *Martin, Bradley.*
1878 *Musgrave, Thomas B.*
1878 *Mason, Lieut. T. B. M., U.S.N.*
1880 *Mills, D. O.*
1882 *Markoe, F. H., M.D.*
1883 *Mackay, Donald.*
1883 *McCreery, James.*
1884 *Moore, Joseph, Jr., Philadelphia, Pa.*
1884 *MacKellar, William.*
1885 *Morison, George S., Chicago, Ill.*
1887 *Morgan, William Fellowes.*
1888 *Marquand, Henry.*
1888 *Mason, Alexander T.*
1888 *Martin, Oswald J., Whitehouse, N. J.*
1888 *McGee, James.*
1889 *Maitland, Alexander.*
1892 *Mills, A. G.*
1895 *McCord, Wm. H.*

Date of Election.
1868 Morrison, Henry.
1872 Meyer, F. William.
1874 Marble, Manton.
1874 Moir, James.
1874 McAlpin, David H.
1875 Mitchell, Edward.
1875 Marcus, Arnold.
1875 McLanahan, Geo. William.
1876 Mitchell, W. Howard.
1879 Miller, John Bleecker.
1882 Marquand, John P.
1883 Morgan, E. D.
1883 Mali, Charles.
1885 Mackenzie, D. E.
1886 Moore, John G.
1886 Moses, Raphael J., Jr.
1887 Malcolm, William L.
1887 Mack, Jacob W.
1887 Mali, Henry W. T.
1887 McCready, N. L.
1888 Morgan, Rev. D. Parker.
1888 Moss, Mrs. J. Osborne, Sandusky, O.
1888 Myers, Theodore W.
1888 Moore, Cary W.
1888 McKeever, J. Lawrence.
1889 Martin, Robt. C.
1889 McCormick, Hon. R. C.
1889 Milliken, James.
1889 Macdonough, James.
1889 Morgan, Wm. H.
1889 Marié, Léon.
1890 Mallory, S. H., Chariton, Iowa.
1890 Mackey, Chas. W., Franklin, Pa.
1890 Montant, Alphonse.
1890 McCarter, Hon. Thos. N., Newark, N. J.
1890 Mackay, J. W.
1891 Meeks, Edwin B.
1892 Miller, Hon. Warner.
1893 Moss, H. O., New Berlin, N. Y.
1895 McMillin, Emerson.
1895 Marcus, Geo. E.
1896 MacCoun, Townsend.
1897 McKeen, James.
1897 Marc, Theophilus M.
1897 Merrill, Wm. F.
1897 Morris, Robt. T., M.D,
1897 Metz, H. L., M.D.
1897 McDonald, John E.
1897 Marshall, Louis.

Date of Election.
1897 Muller, Edward M.
1897 Miller, Geo. C.
1897 Murray, David.
1897 Millar, Geo. W.
1897 Mills, T. M. P., Lakewood, N. J.
1898 Marston, Edwin S.
1898 McAlan, John.
1898 Magerhans, Adolph W.
1898 Miller, Chas. H., M.D.

1886 *Neftel, W. B., M.D.*
1897 *Newell, F. H., Washington, D.C.*
1874 Niles, William W.
1880 Nelson, William.
1886 Notman, John.
1889 Nun, R. J., M.D., Savannah, Ga.
1889 Newton, Daniel H., Holyoke, Mass.
1891 Newkirch, Chas.
1891 Newman, Mrs. Angeline E., Omaha, Neb.
1892 Nichols, O. F.
1893 Nelson, E. B., Rome, N. Y.
1895 Nason, Carleton W.
1896 Nelson, Frank G.
1897 Nevers, Geo. G.
1897 Notman, George.
1897 Nichols, Geo. L.
1897 Nixon, Lewis.

1874 *Ottendorfer, Oswald.*
1875 *O'Connor, Thomas H.*
1875 *Opdyke, William S.*
1879 *O'Brien, Thomas S.*
1880 *O'Shaughnessy, John W.*
1887 *Ogden, William B.*
1888 *Oakes, T. F.*
1895 *Owen, Miss Luella A., St. Joseph, Mo.*
1874 Olyphant, Robert M.
1875 Ottiwell, John D.
1879 O'Gorman, Richard.
1881 Oakley, Henry A.
1882 Oppenheim, Edward L.
1889 Orr, Alexander E.
1893 Operti, Albert.
1896 Owen, James.
1897 Ohman, August R.
1897 Oppenheimer, Sol.
1897 Owen, Mrs. Thos. Jefferson.

Date of Election.
1898 Obermeyer, Joseph.

1852 *Poor, Henry V.*
1872 *Parish, Henry.*
1882 *Parsons, William.*
1882 *Parrish, James C.*
1882 *Parsons, Mrs. E.*
1884 *Plush, Dr. Samuel M., Philadelphia, Pa*
1885 *Post, William Henry, Ogdensburg, N. Y.*
1885 *Planten, J. R., Consul for the Netherlands.*
1886 *Phoenix, Phillips.*
1887 *Phoenix, Lloyd.*
1889 *Pickering, Prof. E. C., Cambridge, Mass.*
1890 *Plumb, Edward L.*
1891 *Porter, Henry Kirke, Pittsburg, Pa.*
1893 *Pierce, Moses, Norwich, Conn.*
1893 *Platt, J. D., Dayton, Ohio.*
1897 *Paton, Wm. Agnew.*
1897 *Parsons, George.*
1871 Peabody, Hon. Chas. A.
1874 Peabody, Arthur J.
1874 Penfold, William Hall.
1874 Pondir, John.
1875 Prentice, W. P.
1875 Porter, Gen. Horace.
1876 Plum, James R.
1880 Pinchot, James W.
1880 Powell, Wilson M.
1881 Post, Charles A.
1882 Pell, Wm. Cruger, Highland Falls, N. Y.
1882 Platt, Hon. Thos. C.
1882 Parsons, John E.
1882 Parsons, Charles.
1884 Post, George B.
1886 Pearsall, T. W.
1886 Pryer, Chas., New Rochelle, N. Y.
1886 Parris, Edward L.
1887 Perdicaris, Ion, Tangier, Morocco.
1887 Parsons, Wm. H.
1887 Peters, Samuel T.
1888 Perry, William A.
1888 Paine, Robert Treat, Boston, Mass.
1888 Phillips, Wm. D.
1889 Palmer, S. S.

Date of Election.
1889 Peck, Charles E.
1889 Putnam, Geo. L.
1890 Perkins, W. H.
1890 Potter, Edward Clarkson.
1890 Palmer, Dr. H. R.
1890 Poor, Henry W.
1891 Powel, De Veaux.
1891 Pinkus, Fred'k S.
1891 Peters, Ed. M.
1891 Pott, James.
1893 Pinchot, Gifford.
1893 Pluygers, Henry.
1894 Pyne, M. Taylor.
1894 Perry, John G., M.D.
1895 Pickhardt, Carl.
1895 Phyfe, James W.
1895 Pease, Walter A.
1897 Pray, Joseph M.
1897 Parsons, Wm. Decatur.
1897 Putnam, Samuel.
1897 Palmer, N. F.
1897 Prudden, Prof. T. Mitchell.
1897 Prentiss, George Lewis.
1897 Porter, Wm. H.
1897 Parsons, Robt. W.
1898 Potter, Frederick.
1898 Preston, Howard W., Providence, R. I.
1898 Phillips, John S.

1883 Quinlin, Leonard G.
1898 Quincey, Mary Perkins.

1868 *Raven, Anton A.*
1872 *Robbins, Chandler.*
1874 *Richard, Auguste.*
1874 *Reynes, Jaime.*
1874 *Russell, Archibald D.*
1880 *Robinson, Mrs. John A.*
1883 *Rowland, Thomas F.*
1886 *Raymond, R. W.*
1886 *Rice, Isaac L.*
1887 *Robb, Hon. J. Hampden.*
1887 *Rowell, George P.*
1887 *Rogers, Archibald, Hyde Park, N. Y.*
1889 *Roelker, Alfred.*
1889 *Reed, J. Van D.*
1868 Rose, Cornelius.
1874 Reid, Hon. Whitelaw.

Date of Election.
1874 Riker, Wllliam J.
1874 Rhoades, John Harsen.
1876 Ross, William B.
1878 Rainey, Thomas, M.D.
1881 Rhinelander, Frederick W.
1882 Robbins, S. Howland.
1882 Rhinelander, Charles E.
1882 Rathborne, C. L.
1888 Rhinelander, Wm.
1888 Renwick, Edward S.
1888 Richter, Dr. C. M., San Francisco, Cal.
1888 Russell, Hon. John E., Leicester, Mass.
1888 Robinson, Wm. M.
1889 Ropes, John C., Boston, Mass.

1889 Rice, Prof. J. M., Northboro, Mass.
1889 Robert, Fred'k.
1889 Roberts, Rev. Wm. C., D.D., Lake Forest, Ill.
1889 Ryan, Thos. F.
1890 Roe, Gen. Chas. F.
1890 Raymond, Chas. H.
1890 Roosevelt, Robt. B.
1891 Robbins, Miss Harriet L.
1892 Ryman, Wm. Penn, Wilkesbarre, Pa.
1895 Reilly, Thos. A.
1895 Rouse, Henry C.
1895 Robbins, Rowland A.
1896 Roncière, St. Croix de la, Point-à-Pitre, Guadeloupe.
1897 Reinhart, Joseph W.
1897 Rubino, Jacob.
1897 Rusch, Henry A.
1897 Rothschild, Frank, Jr.
1897 Richardson, Clifford.
1898 Reynolds, J. B.
1898 Rexford, W. M., Montclair, N. J.

1856 *Schermerhorn, William C.*
1870 *Schafer, Samuel M.*
1870 *Schafer, Simon.*
1872 *Stuyvesant, Rutherfurd.*
1873 *Scott, Julian, Plainfield, N. J.*
1873 *Southworth, Alvan S.*
1873 *Sturgis, Frank K.*
1874 *Schermerhorn, F. Augustus.*
1874 *Strong, Hon. W. L.*

Date of Election.
1875 *Sandford, Elliott.*
1875 *Schiff, Jacob H.*
1876 *Sibley, Hiram W., Rochester, N. Y.*
1878 *Sands, William R., New Hamburg-on-Hudson, N. Y.*
1879 *Stevens, Frederick W.*
1879 *Smith, E. Reuel.*
1880 *Southwick, Henry K.*
1882 *Schuyler, Spencer D.*
1882 *Sayre, Lewis A., M.D.*
1883 *Sinclair, John.*
1883 *Smith, Henry N., Trenton, N. J.*
1886 *Sherman, George.*
1887 *Stetson, George W.*
1888 *Salisbury, Stephen, Worcester, Mass.*
1888 *Stott, Frank H., Stottville, N. Y.*
1888 *Schultze, John S.*
1888 *Sherman, Chas. A.*
1890 *Smith, Sir Donald A., Montreal, Canada.*
1891 *Suckley, Robert B.*
1893 *Sexton, Edward Bailey.*
1897 *Shardlow, Joseph.*
1898 *Schieffelin, Geo. R.*
1856 Spofford, Paul N.
1856 Sherman, W. Watts.
1871 Shaler, Gen. Alexander, Ridgefield, N. J.
1872 Steiger, E.
1873 Sturges, Frederick.
1873 Spencer, James C.
1874 Sloan, Samuel.
1874 Stuyvesant, Robert R.
1874 Sands, Andrew H.
1875 Smith, Lewis Bayard.
1875 Sturges, Henry C.
1875 Stewart, Col. Charles Seaforth, Cooperstown, N. Y.
1876 Stryker, Gen. William S., Trenton, N. J.
1877 Schuyler, Philip.
1878 Stewart, William Rhinelander.
1878 Smith, S. Newton.
1879 Smith, Herbert H.
1879 Shields, Prof. Chas. W., Princeton, N. J.
1879 Stetson, Francis Lynde.
1883 Stone, Sumner R.
1883 Spence, Lewis H.
1883 Smith, William Alex.

Date of Election.
1883 Stern, Louis.
1883 Scott, Rufus L.
1883 Sorzano, Julio F.
1884 Stokes, James.
1885 Schmelzel, Wm. R.
1886 Sherman, Prof. O. T., Boston, Mass.
1886 Satterlee, F. Le Roy, M.D.
1886 Sturgis, F. R., M.D.
1887 Stewart, Lispenard.
1887 Sutton, Rev. J. Ford, D.D.
1887 Schell, Robert.
1887 Seligman, Dewitt J.
1887 Smith, Jas. Rufus.
1887 Smith, Nathaniel S.
1887 Sellew, T. G.
1887 Sterry, George E.
1887 Shortall, John G., Chicago, Ill.
1887 Stevens, George T., M.D.
1888 Stephens, Benjamin.
1888 Smith, A. Cary.
1888 Smythe, Rev. Hugh.
1888 Sheldon, Edwin B.
1889 Smith, Philip Sherwood, Buffalo, N. Y.
1889 Squibb, E. R.
1889 Steinbrügge, E.
1889 Steel, W. G., Portland, Oregon.
1889 Sackett, Henry W.
1889 Straus, Isidor.
1890 Schwarzmann, A.
1890 Sewell, Hon. Wm. J., Camden, N.J.
1890 Snow, Elbridge G.
1890 Simonson, Wm. H.
1890 Schell, Francis.
1890 Schernikow, Ernest.
1891 Stanton, John.
1891 Stieglitz, Edward.
1892 Stokes, I. N. Phelps.
1892 Sherman, Byron, Morristown, N. J.
1892 Starr, Theodore B.
1893 Shaw, Chas. A.
1893 Smith, D. Cady, Schenectady.
1893 Smith, Benj. E.
1893 Swayne, Frank B., Toledo, O.
1893 Stevens, C. Albert.
1895 Sanford, Robert.
1895 Stevenson, Richard W.
1895 Shaw, W. M.
1895 Sands, Robert C.

Date of Election.
1895 Seebeck, Nicholas F.
1895 Stone, Col. Mason A.
1895 Sorchan, Victor.
1895 Squires, Grant.
1895 Scudder, Moses L.
1895 Smith, W. Wheeler.
1897 Standish, Myles.
1897 Stoiber, Louis.
1897 Sheehy, W. H.
1897 Stine, Marcus.
1897 Salomon, Sidney Hendricks.
1897 Schaus, Hermann.
1897 Shethar, Edwin H.
1897 See, Horace.
1897 Stotesbury, Louis W.
1898 Stevenson, Hall E., Garden City, N. Y.
1898 Salomon, Wm.
1898 Sheldon, Chas. H.
1898 Seward, Gen. Wm. H., Auburn, N. Y.
1898 Schouler, James, LL.D., Boston.
1898 Simpson, Wm. T.

1856 *Tiffany, Chas. L.*
1876 *Terry, Rev. Roderick.*
1877 *Talcott, James.*
1882 *Tailer, Edward N.*
1882 *Terry, John T.*
1887 *Thompson, Frederic F.*
1891 *Tobey, Gerard C., Wareham, Mass.*
1893 *Tichenor, Francis M., Newark, N. J.*
1856 Townsend, Randolph W.
1868 Taylor, Douglas.
1872 Tower, Gen. Z. B., U. S. A.
1874 Taylor, Alfred J.
1875 Taintor, Charles M.
1875 Toel, William.
1877 Tillinghast, Wm. H.
1879 Turnbull, Robert J., Morristown, N. J.
1883 Thalmann, Ernest.
1884 Turner, J. Spencer.
1885 Tone, T. Wolfe.
1885 Tiffany, Rev. C. C., D.D.
1885 Turnure, Lawrence.
1886 Thorne, Jonathan.
1887 Ten Eyck, Sandford R.
1888 Tresidder, John R.

Date of Election.
1888 Taylor, C. Fayette, M.D.
1889 Tefft, F. Griswold.
1889 Tatham, Chas.
1889 Trask, Chas. H.
1890 Turner, Elisha, Torrington, Conn.
1890 Thorp, John R.
1890 Thorne, Samuel.
1891 Thaw, Benjamin, Pittsburg, Pa.
1891 Toop, George H.
1891 Taber, Chas.
1891 Townsend, Jas. B.
1893 Truesdell, Warren N., Newark, N. J.
1895 Taylor, George.
1895 Thomas, Allen M., M.D.
1896 Tilton, Edward L.
1897 Thomas, Geo. C.
1897 Travis, John C.
1897 Tonnelé, Walter.
1897 Tanner, Frederic A.
1897 Treacy, Richard S.
1898 Thompson, D. W.
1898 Thompson, Walter, Garrison, N.Y.

1888 *Uhl, Edward.*
1897 *Underhill, Eugene.*
1891 Ulmann, Ludwig.
1891 Ullmann, Emanuel S.
1895 Underhill, Francis M.
1897 Untermyer, Maurice.
1898 Untermyer, Samuel.
1898 Upham, J. Baxter, M.D.

1870 *Van Brunt, Hon. Charles H.*
1875 *von Post, H. C.*
1877 *Vanderbilt, Cornelius.*
1878 *Vanderbilt, William K.*
1887 *Van Alen, J. J., Newport, R. I.*
1887 *Van Slyck, George W.*
1889 *Vanderbilt, George W.*
1891 *Van Winkle, Edgar B.*
1854 Viele, Gen. Egbert L.
1875 Van Buren, John D.
1876 Van Hoesen, Hon. Geo. M.
1885 Valentine, Henry C.
1887 Verastegui, Alberto, Havana, Cuba
1888 Villard, Henry.
1888 Ver Planck, Wm. G.
1889 Van Devanter, Willis, Cheyenne, Wyoming.
1890 Valentine, Ferdinand C., M.D.

Date of Election.
1890 Vose, Geo. H.
1893 Van Antwerp, J. H., Albany.
1895 Vanderpoel, Waldron B., M.D.
1897 Van Antwerp, William C.
1897 Van Slooten, William.

1870 *Wilson, Gen. James Grant.*
1872 *Wetmore, William Boerum.*
1873 *Wiener, Joseph, M.D.*
1874 *Wetmore, Hon. George P.*
1878 *Whitehead, Henry M.*
1879 *Watson, Francis A.*
1882 *Waddingham, Wilson.*
1882 *Williams, David.*
1884 *Watson, George H.*
1886 *White, Hon. S. V.*
1887 *White, Julian Leroy, Baltimore, Md.*
1888 *Woodward, James T.*
1890 *Williams, Norman, Chicago, Ill.*
1890 *Wadsworth, Herbert, Avon, N. Y.*
1892 *Wilson, J. B.*
1895 *Willets, Robert R.*
1898 *Wadsworth, Wm. Austin, Geneseo, N. Y.*
1898 *Watkinson, George, Philadelphia.*
1854 Webb, William H.
1868 White, Alexander M.
1870 Ward, T. W.
1875 Winslow, Gen. Edward F.
1876 Wedemeyer, A.J. D., Liberty, N.Y.
1881 Wilson, John.
1884 Wood, Wm. H. S.
1886 Wright, Wm. Phillips.
1886 Wiman, Erastus.
1886 White, Horace.
1887 White, William Aug.
1887 White, Alfred T.
1887 Wilson, J. Wall.
1887 Wheelock, George G., M.D.

Date of Election.
1887 White, Henry, London, Eng.
1887 Westcott, Clarence L.
1887 Welling, W. Brenton.
1888 West, Hon. George, Ballston Spa, N. Y.
1888 Witherbee, Frank S.
1888 Wynkoop, G. H., M.D.
1888 Wetmore, Edmund.
1888 Winslow, Dan.
1889 Waterbury, John I.
1890 Weir, Chas. G.
1890 Wells, Edward, Jr.
1891 Wolcott, Henry Roger, Denver, Colo.
1891 Whitney, Hon. Milton B., Westfield, Mass.
1891 White, Miss Georgiana.
1893 Wills, Chas. T.
1895 Wells, Charles W.
1895 Winston, Frederick J.
1895 Warren, Wm. R.
1895 Washburne, A. L.
1895 Woodford, M. D.
1897 Wenman, James F.
1897 Westover, M. F., Schenectady.
1897 Wolff, Emil.
1898 Whitfield, R. P.
1898 Walker, Wm. Augustus.
1898 Woods, John A.
1898 Wait, Wm. B.
1898 Wales, C. M.
1898 Wolfe, J. Burke.
1898 Wilkins, Hartwell A.
1898 Warner, Chas. Dudley, Hartford.

1891 Young, Edward L.
1895 Young, Richard N.
1898 Young, Reginald.

1884 *Zabriskie, Andrew C.*

# BULLETIN

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# American Geographical Society.

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## PHYSICAL GEOGRAPHY OF NEW YORK STATE.


BY

RALPH S. TARR.


### PART V.—THE RIVERS OF NEW YORK.*

Preglacial Drainage.—In the present state of our knowledge it is quite impossible to tell much about the preglacial condition of New York drainage. As was stated in a previous article of this series,† there is reason for believing that in immediate preglacial times there were few, if any, lakes within the boundaries of the State. Another fact of the preglacial drainage is that before the ice came there were streams where the present large valleys now stand. In other words, the larger features of hill and valley are preglacial in origin.

At present it is difficult to go much further back in time than this. The history of the development of the preglacial drainage lines has evidently been long and complex. Born near the close of the Palæozoic, during the Appalachian uplift, there have been abundant changes in the drainage lines. From the history of this uplift one may well believe that the main original drainage of the State was northward and westward. As a result of the Appalachian uplift, and of the extension of this northward into Canada, combined with the mountain uplifts of earlier times in New England and the Adirondacks, there existed a range of highland in the east, extending from Canada to the Southern States, which must early

* For a general account of the drainage of New York, see Henry, Trans. Albany Inst., I, 1830, 87–112; Ballou, Amer. Nat., 1880, XIV, 139–140.

† Tarr, Bull. Am. Geog. Soc., 1898, XXX, 185.

have prohibited extensive drainage eastward from any part of New York. Westward and northward from this line of uplift there stretched extensive plains, over which streams from the rising mountains must have extended themselves as the plain increased.


From a drainage map of the eastern United States it is easily seen that this supposed original drainage, consequent upon the initial topography, is far different from the present. Through the

Mohawk and Hudson rivers a considerable part of New York now drains eastward and southward into the Atlantic; and through the Delaware and Susquehanna a very considerable area also drains eastward across the folded rocks of the uplifted Appalachians; but the remainder of the drainage extends either westward or northward, as most of it probably did extend at first.

If this view of the early drainage of the State is correct, it becomes of marked interest to discover how it happened that streams passing westward and northward have been so changed that the drainage now finds its way across folded mountains in an easterly direction. Unfortunately, the answer to this is not ready.

It is, however, a fact that for a long time during the Mesozoic and the early Cenozoic, the northeastern part of this country was subjected to long-continued denudation, at the end of which the surface was certainly reduced to the condition of a low, hilly country, even in the most mountainous sections. Some believe that it was reduced to the condition of a low, almost featureless, plain, a peneplain.* During this long denudation there was ample time for streams to slowly adjust themselves to conditions of rock structure and position, and to slowly change their courses in order to adapt themselves to the existing conditions. For instance, the west- and north-flowing streams then had a long course over a moderate grade, reaching the ocean only after passing either to the Arctic, or to the North Atlantic near the Gulf of St. Lawrence, or to that sea which was the ancestor of the present Gulf of Mexico. On the other hand, the streams that flowed eastward, on the eastern slope of the mountains, had a short, steep slope, partly due to the mountain uplift, which was still further increased in the early Mesozoic at the time of that subsidence of the land which permitted the Triassic ocean to encroach upon eastern New Jersey and the neighboring corner of New York. This lowered the land to the east, and must have given to the east-flowing Appalachian streams an additional slope.†

East-flowing streams, therefore, had in general a more favorable position for rapid extension of headwater conquest than the west- and north-flowing streams. As a result of this battle between the headwaters of the two opposing sets of rivers, the more favorably situated ones may well have encroached upon those less favorably situated, and slowly forced the divide westward, until streams on

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* See statement of this in Article III of this series, Bull. Amer. Geog. Soc., 1898, XXX, 55; and also Tarr, Amer. Geol., 1898, XXI, 351–370

† See Davis, Nat. Geog. Mag., 1889, I, 195.

the Appalachian plateau were allowed to cross the Appalachians directly to the Atlantic.*

Succeeding the lowland condition of the northeastern section of the country, there came, during the Tertiary time, an uplift of the land which was greater in the north than in the south; and at that time the general surface of New York was raised until it stood at a level considerably higher than at present. The evidence of this uplift is complete and will be stated in a later article. It seems entirely within reason to think that one of the results of this uplift may have been a change in the course of some of the rivers; for it is evident that such an uplift will increase the energy of one set of streams and decrease the energy of the opposing set, so that headwater erosion, and the conquest of stream territory, is rendered more easy. This uplift would have worked in the favor of the south- and east-flowing streams, and it may in part account for some of the changes in the New York State drainage. As will be shown when discussing the Mohawk (page 399), still other changes have been brought about by the glacial invasion.

It should be understood clearly that this statement of the early drainage history stands for little more than a mere suggestion. It deals with changes which are so far in the past that the facts necessary to prove the conclusions are difficult to find, and perhaps even impossible to discover. Certainly, with the facts so far found, and the studies that have so far been made, little more light has been thrown upon the question of the early drainage history of New York than is contained in the general and rather vague hints just put forth.

Concerning the changes since the immediate preglacial time, we have less difficulty in determining the facts necessary to prove the history. Our difficulty here comes chiefly from the fact that little study has been given to the problems, though there is added difficulty from the fact that in many cases the old preglacial valleys are too deeply drift-filled to permit any certainty of conclusion.

In a number of cases, however, studies have been made with sufficient care to warrant certain conclusions concerning changes in the preglacial drainage; and it is evident that changes both of a small and large kind have been caused by the ice invasion. A few of these will be considered in some detail to serve as types. There are numerous other similar changes known, and undoubtedly a great many more will be discovered when the proper studies have been made. These type instances will be considered by examples selected

* See Davis, Nat. Geog. Mag., 1889, I, 183–253.

first from western New York, then from central, and finally from eastern New York.

The Upper Allegheny.—The glacier front stood for a long time in the southern part of Chautauqua and Cattaraugus counties, and while there built extensive moraines. Numerous oil borings in southwestern New York, and the neighboring part of Pennsylvania, show that the drift deposits in the valleys are heavy. Some of these are in the nature of overwash plains and valley trains, but others are evidently lake deposits. North-flowing streams were ponded back by the ice dam and caused to overflow toward the south, forming lakes, the evidence of which may be seen in several of the valleys. From the filling of these valleys by glacial, stream and lake deposits, and from the cutting down of divides at the point of outflow, one may well expect to find some rivers actually reversed in their course, having originally flowed northward and now turned southward. With the long stand of ice front here, and with the evidence from deeply drift-filled valleys, such a result would normally be expected.

Another point suggesting a reversal of drainage is the nearness of the Erie-Allegheny divide to Lake Erie. From the breadth of the valleys occupied by the Great Lakes, it seems evident that in preglacial times there must have been good-sized streams in the valleys. Yet the present divide between the Erie-Allegheny drainage is so near Lake Erie that, in places, one may stand upon it in plain sight of the lake. While this is not an *impossible* condition of drainage, it is distinctly unlikely that the divide of the tributaries to a large stream shall be so near the main stream. That this is an unnatural condition caused by some change in stream course is further indicated by the fact that the present divide is situated among the lower hills, amidst broad valleys, while to the southward, in the Pennsylvania plateau, the land is much higher and the valleys distinctly narrower. The real preglacial divide between the north- and south-flowing streams in this section seems, then, to have been not where it now is, but in Pennsylvania considerably south of the New York boundary.

It is to Carll* that we owe the positive proof that this conclusion is correct. He has shown very clearly that the Allegheny valley narrows up near Thomson's Gap, decreasing in width, from its normal breadth of about a mile, to about a quarter of a mile. Moreover, he has shown that the borings through the drift, which were made

* Second Geol. Survey Pennsylvania, Rept. III, 1880, 330–366.

for oil, prove that, from this narrow gap northward, the real *rock floor* of the valley slopes northward instead of southward, as the drift-filled valley now slopes and the present stream flows. His conclusion therefore is, that the upper Allegheny, now tributary to the Ohio, was in preglacial times a north-flowing stream passing into the river that occupied the basin of Lake Erie.

In searching for the preglacial valley that carried its waters northward, Carll was not able to prove the exact place of outflow so satisfactorily as he had the fact of reversal; but, after considering the several possible valleys, decided that the outflow was probably through the Cassadaga Valley into Lake Erie near Dunkirk.


FIG. 2.—FOSHAY'S ATTEMPT AT A RECONSTRUCTION OF THE PREGLACIAL DRAINAGE OF WESTERN PENNSYLVANIA AND NEW YORK.

Foshay* accepts this work of Carll and proposes the name Carll River for this ancient preglacial river. Chamberlin and Leverett† likewise accept Carll's conclusions, excepting for the preglacial Cassadaga course. They show that wells in the Connewango Valley passed through 284, 314, 330 feet of drift without reaching rock, showing a deeply drift-filled valley, the continuation of which they placed further east than the Cassadaga. Their conclusion is that the preglacial course of the Upper Allegheny was into Lake Erie through the Cattaraugus Creek, which enters the lake near the town of Silver Creek (Figs. 3 and 4).

Foshay‡ shows that this is not the only important change in the direction of the tributaries of the Ohio. Following the suggestion of Spencer§ he studied the region of the Beaver River and has shown that the Lower Allegheny, the Monongahela and the Upper Ohio rivers united at the Beaver River and together entered Lake Erie through the Grand River. For this preglacial stream, now broken

* Amer. Journ. Sci., 1890, XL, Ser. III, 397–403.

† Amer. Journ. Sci., 1894, XLVII, Ser. III, 247–283.

‡ Amer. Journ. Sci., 1890, XL, Ser. III, 397–403.

§ Amer. Phil. Soc. 1881, XIX, 300–337.

up into several parts, Foshay has proposed the name Spencer River (Fig. 2). As will be seen by the map (Fig. 4), Chamberlin and Leverett accept his conclusions in the main. It is evident that other similar reversals have occurred farther west in Ohio, so that if the Erie Basin could have its preglacial drainage, instead of being entered, as at present, by only a number of small streams, it would have several quite large tributaries, while the Ohio would be correspondingly reduced by the reversal of the tributaries which were given it as a result of the glacial invasion.

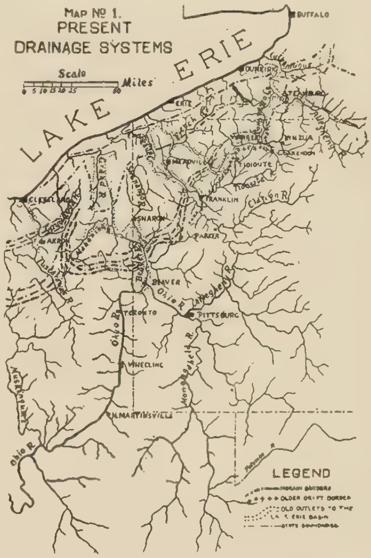


FIG. 3.—PRESENT DRAINAGE OF UPPER OHIO WITH LAKE BEACHES AND MORAINES INDICATED (CHAMBERLIN AND LEVERETT).

THE "GULFS" OF WESTERN NEW YORK.—One of the striking topographic features of the Erie escarpment of Western New York, in Chautauqua County, is the presence of numerous narrow gorges, locally called "gulfs," which breach the face of the escarpment. The small streams, flowing from the uplands of the Chautauqua County plateau, have carved steep-sided gorges in the soft Devonian shales. These are young postglacial valleys, having their origin in the fact that the drift deposits have partially, and in some cases almost completely, obliterated the preglacial valleys by filling. In some places these preglacial valleys are indicated as sags in the hillsides, occupied by streams, and sometimes by streams which have not yet cut down to the bed rock. In such cases the postglacial valleys are rather broad

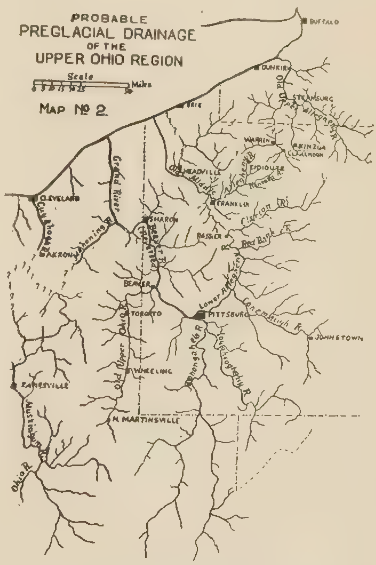


FIG. 4.—RECONSTRUCTION OF PREGLACIAL DRAINAGE OF UPPER OHIO REGION (CHAMBERLIN AND LEVERETT).

gorges carved solely in the glacial accumulations. Elsewhere the streams flow entirely outside of the preglacial valleys, and then they have carved rock gorges, frequently with waterfalls. Not uncommonly, however, the streams have their courses for the most part in preglacial valleys; but, owing to drift-filling of irregular form, they are often turned aside from the central axis of the valley, so that, after cutting through the drift, they find themselves at times superimposed upon the bed rock at one side of the valley. In such cases the "gulfs" are narrow, rock-walled gorges in places, and broad, drift-walled gorges in others, where their course is more nearly in accord with the preglacial valley axis. The scenery thus produced is quite like the gorge scenery of central New York (p. 390), where the conditions, both as to local structure and cause, are quite similar.

Drift-filled Valleys Along the Lake Shore.—Besides the partially obscured valleys on the face of escarpment, and the drift-filled valleys of the plateau, there are similar buried valleys along the shores of the lake. This is proved by the fact that the rock cliff along the shores of Lake Erie is here and there interrupted by stretches of drift without rock, notably at Dunkirk and Silver Creek. The bottoms of these valleys are below lake level, and in the case of the Cattaraugus Creek, which Chamberlin and Leverett believe to be the former course of the Upper Allegheny, the drift-filling is at least 95 feet below the present lake level. This was shown by a well boring at Versailles, seven miles from the lake, where the well did not reach rock at a depth of 95 feet below lake level. This tends to prove that preglacial Lake Erie Valley was lower than the present lake surface; and, together with similar facts elsewhere, this has an important bearing on the question of the preglacial history of the Great Lakes.

No attempt will be made to discuss the question of the Niagara River and the Great Lakes in this paper, though at this point we may refer to the fact that, in the course of the gorge-cutting by the present Niagara, a buried channel has been revealed at the whirlpool, and that this extends northward to the edge of the escarpment at St. David's. The exact meaning and history of this buried valley is not yet clearly understood, though there is some reason for supposing it to be the course of the Tonawanda Creek before the last invasion of the ice. It cannot properly be considered to be the preglacial course of the Niagara River, for whatever the preglacial drainage of the Great Lake area may have been,

there is no reason for thinking that the course of one of the streams of the system was along the line of the present Niagara River.

Nor does this buried gorge from the whirlpool to St. David's coincide exactly with our idea of a preglacial valley. During all the time that it had for development, such a valley should be broad, with somewhat rounded sides, having reached the form of early maturity; but this valley is a distinctly narrow, steep-sided gorge with youthful characteristics. It has been suggested that the buried gorge is really interglacial, formed possibly by the Tonawanda Creek during the interval between the first and second advance of the ice sheet.

It does not require a long nor a very detailed study of the drainage features of northern and western New York to see that this gorge condition of parts of valleys, now filled or partially obscured by drift, and hence antedating the last advance of the ice, is a feature that will have to be taken into full consideration before the studies of the drainage history are complete. Some cause has introduced gorges of earlier date than the drift-filling, and has introduced them in connection with distinctly preglacial valleys. What this cause is I am not yet prepared to state, though interglacial stream-cutting seems the best hypothesis in the present stage of the investigation. This question will be briefly considered again below (p. 395).

THE GENESEE RIVER.—Owing to the early settlement of Rochester, and the presence of the falls there, the lower part of this valley early attracted attention, and it was recognized that the lower gorge has been carved out by the action of running water.* The first description at all adequate was by Hall,† who states some of the more important facts in the history of the valley.

The Genesee is the only river which crosses the entire State, rising in Pennsylvania, just south of the boundary, and flowing northward into Lake Ontario, just to the north of Rochester. The valley presents some interesting peculiarities, for there are four quite distinct parts to it.‡ From the headwaters to Portageville (Fig. 5) the river flows in a broad, mature valley, evidently preglacial in age, and partly filled and broadened in the centre by

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* See, for instance, Bigsby, Amer. Jour. Sci., 1820, II, 250–54 ; Wadsworth, Same, 1830, XVIII, 209–210; Silliman, Same, 1830, XVIII, 210–211; Hall, Geology of New York, Fourth Dist., 1843, 377–382.

† Geol. of New York, Fourth Dist., 1843, 342–347; 368–374.

‡ Grabau, Proc. Boston Soc. Nat. Hist., 1894, XXVI, 359–369.

a deposit of drift. At Portageville the valley abruptly changes its character, for the stream here enters a rocky gorge, through which it passes for over 25 miles as far as Mt. Morris. "This gorge varies in width from six hundred to about eight hundred feet, and its sides are mostly perpendicular, rising in places to a height of four hundred feet or more. In this gorge are situated the three celebrated Portage Falls"—the first having a height of 66 feet, the second of 110 feet and the third of 96 feet.*

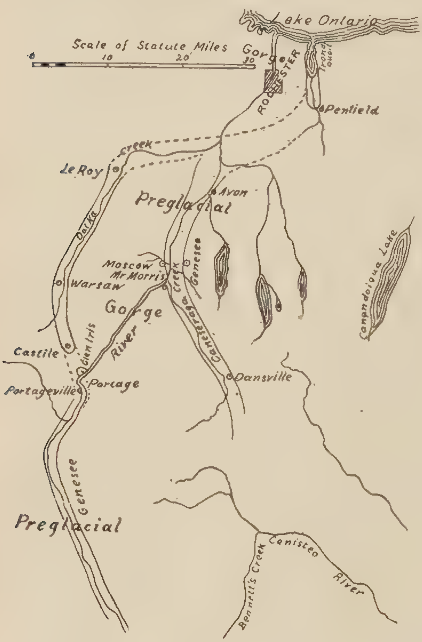


FIG. 5.—MAP SHOWING CONDITION IN GENESEE VALLEY WITH PROBABLE PREGLACIAL COURSE INDICATED (GRABAU).

Below the gorge, from Mt. Morris to Rochester, the valley is again broad and preglacial in characteristics, though wider than the upper valley. The bottom of this part of the Genesee Valley is drift-filled to the depth of at least one hundred or two hundred feet. A part of this filling is due to the presence of a lake that was dammed back by the glacier when it reached across the valley.† At Rochester the river enters a second gorge, and for seven miles flows through it until Lake Ontario is reached. In this postglacial gorge there are three falls, the upper one, over the hard Niagara, being 98 feet high, the second, over the Clinton, 20 feet high, and the third, over the hard upper Medina sandstone, being 105 feet high.‡

So the valley is a complex of two preglacial and two postglacial courses. To the west of the middle Genesee there is a broad preglacial valley occupied by the Oatka Creek. It is fully a mile wide, which is about the width of the Genesee above Portageville, and it is quite deeply drift-filled, as is the Genesee itself, the drift being a

* Grabau, Proc. Boston Soc. Nat. Hist., 1894, XXVI, 359–360.

† Hall, Geol. of New York, 4th Dist., 344; Davis, Proc. Boston Soc. Nat. Hist., XXI, 1882, 361; Grabau, Proc. Boston Soc. Nat. Hist., XXVI, 360; Fairchild, Bull. Geol. Soc. Amer., 1896, VII, 434–452.

‡ Grabau, Proc. Boston Soc. Nat. Hist., 1894, XXVI, 361.

hundred and fifty to two hundred feet deep. This valley seems altogether too large for so small a stream to make. While the direct connection between this and the upper Genesee has not been discovered, Grabau is of the opinion that the Oatka Creek really represents the continuation of the preglacial upper Genesee. Chamberlin * points out that there is much moraine and massive glacial deposits near Portageville, and suggests that the real channel

FIG. 6.—LOWER GENESEE FALLS.

of preglacial Genesee lies to the east of the gorge course, instead of to the west, as Grabau has suggested.

To the east of the middle Genesee there is another broad preglacial valley, occupied by the Caneseraga Creek, which joins the Genesee just below the Portageville-Mt. Morris gorge. This valley appears to be the preglacial tributary of the middle portion of the Genesee. According to the views of Grabau, which have been stated more fully in his paper, the upper Genesee turned westward

* 3d Annual Report, U. S. Geological Survey, 1883, 351.

into the Oatka Creek and joined the valley now occupied by the Genesee at some point below Avon. This river received the tributaries occupying the valley now the site of Caneseraga Creek and the middle preglacial portion of the Genesee. The exact place of union of these two streams has not been proved.

The postglacial gorge from Rochester to Lake Ontario represents a farther turning aside of the preglacial stream, which forced it to cut into the rock. To the east of Rochester there is a broad valley extending from the lake to Penfield. At the north it is fully a mile wide, where it forms a bay called Irondequoit Bay, which is partially shut off from the lake by a sand-bar. This valley is at least 250 feet deep. The suggestion naturally arises that the Irondequoit Bay represents the preglacial course of the lower Genesee, and this suggestion was actually made by Hall as long ago as 1843.* It has since been restated by Dryer†; and Grabau ‡ thinks that it was at least the former outlet of the preglacial Caneseraga, and, if the Genesee united with this, of the Genesee also. There are extensive drift deposits near Rochester consisting of moraines, kames and drumlins, so that the ancient valley may well be entirely obscured by these deposits.

There are probably other changes in the Genesee valley, especially about the headwaters, as there are further east in the Finger Lake region (p. 389); but no work has been done upon this region. With reference to the changes recorded above, it may be stated that, while some points are as yet uncertain, it seems that the two gorges call for some such changes as those outlined; and, while the conclusions of Grabau may be somewhat modified in detail by future studies, the main fact, that the present Genesee follows a course which is different from the preglacial course in the two gorge portions, may be considered proved, and the suggested course extremely probable.

THE CHEMUNG VALLEY.—So far as I can find, no one has studied the conditions in the upper Susquehanna and its tributaries. Having worked to some extent in this valley, I have seen that there are problems of importance connected with the changes in river course. It is not improbable that some of this drainage found its way northward through the valley of Seneca Lake; but the evidence of this is not yet complete enough for a discussion of the subject.

* Hall, Geol. of New York, Fourth Dist., 1843, 344, 422.

† Amer. Geol., V, 1890, 202–207.

‡ Proc. Boston Soc. Nat. Hist., XXVI, 1894, 364.

Nevertheless it should be pointed out that at Havana, four miles south of the lake, a well in the middle of the valley passed through


FIG. 7.—ELMIRA SHEET SHOWING ABANDONED PREGLACIAL VALLEY (U. S. GEOL. SURVEY, TOPOGRAPHIC MAP).

135 feet of drift without reaching rock,* and that six miles south of this a well 186 feet deep did not reach rock. From this it is seen

* Lincoln, Amer. Journ. Sci., 1894, XLVII, Ser. III, 109.

that the valley is deeply drift-filled, being occupied by a heavy deposit of moraine. It is also a broad valley and may possibly represent the course of a north-flowing preglacial stream, receiving tributaries from south of the present divide. In any event, it is certain that the present divide is determined by drift deposits, not by the bed-rock outline, as it was in preglacial times, and therefore that its present position is not the exact preglacial one.

One notable change of glacial origin is illustrated on the Elmira sheet of the U. S. Geological Survey (Fig. 7). It will be seen that the Chemung, flowing from the west in a broad valley with flat bottom, abruptly leaves it, passing through a very narrow valley behind a large and high hill, and emerges again into the old broad valley at Elmira. In doing this, it makes a shorter cut from near Big Flats to Elmira; but while this is true, it is noticeable that the stream leaves what was evidently its preglacial course past Horseheads.* No rock is found in the stream bed, either in the broad main valley or in the narrow valley now occupied by the river. It is evident from this that the Chemung has not made a postglacial cut in passing from Big Flats to Elmira.

The conditions of the valley are these: A massive moraine occupies the upper or southern part of Seneca Valley as far as Pine Valley; and while the ice was standing there building this moraine, floods of sediment-laden water were poured into the Chemung, to which were added other contributions from the tributary streams to the west of this. These glacially furnished gravels form a notable part of the filling of the abandoned Chemung Valley.† The flat-bottomed valley is the product of the overburdened condition of glacially supplied water, and it forms a very typical overwash plain.

Prior to this flooding there had been two small tributaries to the Chemung heading on the southern side of the hill, in the narrow valley now occupied by the Chemung. From the map one will see where the preglacial divide was situated; for the valley behind the hill broadens both ways from this narrow divide section. The glacial floods choked these small tributaries with sediment until their bottoms were raised above the level of the divide between

* This valley has been studied by Mr. N. H. Farnham, of Cornell, who has written an undergraduate thesis upon the subject and deposited it in the Cornell Library. To Mr. Farnham I am indebted for some of the facts stated here. Space prohibits a full statement of all the evidence, which will be published in due time elsewhere.

† There are other deposits than these in the valley, notably till, partly, and in places completely, buried beneath the gravels.

them, so that, when the sediment supply ceased, it was possible for the Chemung to pass behind this hill, being prevented from flowing through the old valley because of the slightly greater elevation there, caused, no doubt, by the fact that the sediment supply was greater from the Seneca Valley than from the others, thus causing a more rapid filling near Horseheads than in the more remote valley near Big Flats and along the present narrow course of the Chemung. The evidence of these changes is quite complete.

Reversal of Drainage near Lake Cayuta (Fig. 8).—Doubtless there are hundreds of cases of changes in drainage in New York similar to these which have been discussed, though practically nothing has been published upon them. As further illustration of accidents to river courses, I propose to state some of the changes near Cayuta Lake which have been carefully studied. These will serve as illustrations of types rather than because of their intrinsic importance.


FIG. 8.—TO SHOW PRESENT AND PREGLACIAL STREAM COURSES NEAR CAYUTA LAKE.

Extending from Cayuta Lake southwest to the Seneca Valley is a broad valley choked with extensive morainic deposits. It is a direct continuation of the Cayuta Lake valley (see U. S. topographic map, Ithaca sheet), and yet the outflow of the lake is not through this broad valley, but southeast, passing through a narrow gorge cut in the hills.* If the water went as one would expect from the general topography, and as it evidently did in preglacial times, it would have entered Seneca Lake and thence have passed northward, provided the stream occupying this valley flowed as the water now runs. Instead of this it now passes southward into the Atlantic through the Susquehanna.

* This appears to be an interglacial cut. See p. 395.

There are other changes near here. By examining the Ithaca sheet of the U. S. Geological Survey* it will be noticed that a series of hills stretch across the valley of Pony Hollow at the place which is now the divide. These hills are a part of the terminal moraine, and their height has prevented the postglacial streams in that vicinity from taking their preglacial course. The real preglacial divide of the Pony Hollow stream is near Newfield on one branch, and near Trumbull's Corners on the other. By the filling of the Pony Hollow valley this stream has lost fully half of its volume. This amount of water has been turned from the Seneca Valley into the Cayuga. In addition to the moraine filling in Pony Hollow valley, there are also extensive deposits of overwash material, which have transformed the valley bottom to a broad overwash plain.

Cayuta Lake and the Pony Hollow stream, in preglacial times larger than now, at present unite to form Cayuta Creek, which flows southward to the Susquehanna. The map shows the valley narrowing in the direction of flow of these streams until Cayuta Creek reaches a narrow gorge, south of which the valley again broadens. The topographic evidence here, therefore, points to another case of reversal, the site of the gorge being a divide similar to that of Thomson's Gap in the Upper Allegheny. Other topographic evidence points toward the westward flow of this part of Cayuta Creek, with its tributaries from the Pony Hollow stream and Cayuta Valley, all of which flowed westward into the Seneca stream through a broad valley now deeply drift-filled and occupied by only one or two very tiny streams. Evidence of these changes is only less complete than that of the Allegheny by the absence of borings to show that the conclusions from topography are verified by rock bottom slope.

GORGES OF THE FINGER LAKES REGION.†—In Central New York there are many postglacial gorges cut in the Devonian shales, and in them are a great number of picturesque waterfalls. In each case they represent a new stream course caused by diversion resulting from drift deposits. While each case presents peculiarities of its own, I shall select only a few near Ithaca to serve as types of the others, among the most noted of which are Watkins and Havana Glens at the head of Seneca Lake. The region about Ithaca, as also that

* Figure 15, opposite page 50, Bull. Amer. Geog. Soc. XXX, 1898.

† Hall, Geol. of New York, 4th Dist., 1843, 377–382; Macfarlane, Science, IV, 1884, 99–101; Lincoln, N. Y. State Museum Rept., XLVIII, Part 2, 1894, 67–68.

about Seneca Lake, and the head of the other Finger Lakes, is one of heavy drift deposits, connected with the moraine of the "second glacial epoch".* The ice passed rather freely along the axis of these north-south valleys and partially scoured them out; but the tributaries from east and west, instead of being deepened, were shallowed by drift deposit,† especially near the lake valley. Consequently, when the streams began to flow after the ice had withdrawn, they were often obliged to seek new courses because their old valleys were so deeply drift-filled. This was the cause for the gorges, and the waterfalls have developed during the process of gorge-cutting.

FIG. 9.—GREEN TREE FALLS IN A POSTGLACIAL GORGE SECTION OF SIX MILE GREEK (J. O. MARTIN, PHOTOGRAPHER).

In the case of Six Mile Creek, which enters the Cayuga valley from the east at Ithaca, the postglacial stream occupies the preglacial valley throughout its distance; but, because of the drift-filling, it is not now flowing at all places along the *lowest* part of the old valley. So, as in the case of some of the "gulfs" of Chautauqua County, this creek has in places cut through the drift to find itself superimposed upon the rock wall of a part of the old valley. Where this is the case, we have a rock-walled gorge, often with falls and rapids, while in the other parts the valley is broad and drift-walled, forming what are locally known as "amphitheatres." In passing up this valley one comes first into a gorge, then into a broad amphitheatre, and again into another gorge, etc. Each gorge represents a place where the postglacial stream has

* Tarr, Bull. Amer. Geog. Soc., XXX, 1898, 196.

† Tarr, Bull. Amer. Geog. Soc., XXX, 1898, 215–216.

cut into the rock banks of the preglacial valley; and each amphitheatre a place where the present stream flows near the centre of the preglacial valley, so that it has not yet reached the old rock floor.

Buttermilk Creek, south of this, occupies its preglacial course down to the distance of about a mile from the Cayuga valley, where it leaves it and cuts a rock gorge, while the preglacial valley is traceable just north of the gorge, where it is seen in the form of a broad valley filled with drift. The conditions at Fall Creek are similar to Buttermilk, the old valley being here also to the north of the postglacial gorge; and the same is true of Taughannock gorge, in which is found the highest fall in the State, where the water falls vertically for a distance of 215 feet. Here the old valley is also north of the postglacial gorge. Coy Glen, southwest of Ithaca, presents similar conditions, but here the preglacial valley is *south* of the postglacial.

FIG. 10.—TAUGHANNOCK FALLS AND GORGE.

In all these cases the old valley is abandoned by the stream at a distance of one or two miles from the lake valley. There are reasons for this, one being that the preglacial valleys are more completely obliterated by drift-filling near the lake than on the high land farther back from it. Another is that, as the ice went down the Cayuga valley, glacial erosion scoured not only the bottom but the sides, thus lowering the tributary valley walls so that less filling was necessary to obliterate them. The third reason for the abandonment of the preglacial valley is the lake deposits; and this is the most important, especially in determining the exact course of the

lower or gorge part of the streams. This calls for a fuller statement than the others.

When the ice was leaving it the Cayuga Lake valley was occupied by a lake, dammed back by the glacier,* and the evidence of this is found in the form of remarkably well developed deltas opposite the stream mouths. These deltas completed the filling of the preglacial valleys in places, so that, when the lake had disappeared, the new river courses, down the hillside into Cayuga Lake, were determined by the position that the streams happened to then have upon the deltas which

FIG. 11.—LOOKING INTO DRIFT-FILLED VALLEY OF PREGLACIAL (INTERGLACIAL?) TAUGHANNOCK.

were just being abandoned. Each stream naturally began cutting a gorge at the very place where it was flowing at the time the lake disappeared, and this accounts for the very remarkable condition at Taughannock Falls, where the new course has been begun on the hillside instead of in the lower ground of the partially filled preglacial valley. The first place where the stream leaves its preglacial valley is, therefore, at the site of the uppermost delta; and, as the lake dropped by successive stages, indicated by successively lower deltas, the course was locally redetermined by the lower deltas during the process of lake withdrawal.

The presence of the new gorges on the *south* side of the old valleys, which is the prevailing condition, is due to the effect of the north winds on the extinct lake, which forced the deltas, and therefore the river courses, to the southward. The reason why this is not so in the case of Coy Glen is that its situation is protected from the north winds, but exposed to those from the south. What is said of

* Fairchild, Bull. Geol. Soc. Amer., 1895, VI, 353–374.

these specific cases will apply in general to many of the other gorges of the Finger Lakes.

In the gorges are many remarkable waterfalls. Of these there

FIG. 12.—ITHACA FALLS AT THE OUTLET OF FALL CREEK GORGE NEAR THE CORNELL CAMPUS.

are two main types: one represented by Taughannock (Fig. 10), where the fall is straight down, and the other by the Ithaca Falls (Fig. 12), where the falls consist of a succession of steps. The

former is the Niagara type, and occurs where there is a hard layer to hold the fall at that level; the latter is found either where there is no unusually hard layer, or else where there are several hard strata near together with intermediate beds of soft rock.

These falls are in process of change, the Niagara type moving upstream, and maintaining their height at the level of the hard stratum, while the second type is becoming transformed to rapids (Fig. 13). In both cases they had their birth as a result of the accident which turned streams to one side of their old courses, and caused them to tumble down a steep hillside, in which they have undertaken the task of carving a valley, which has now reached this stage of development, varying slightly under different conditions, but in all cases being a gorge with rapids and falls.

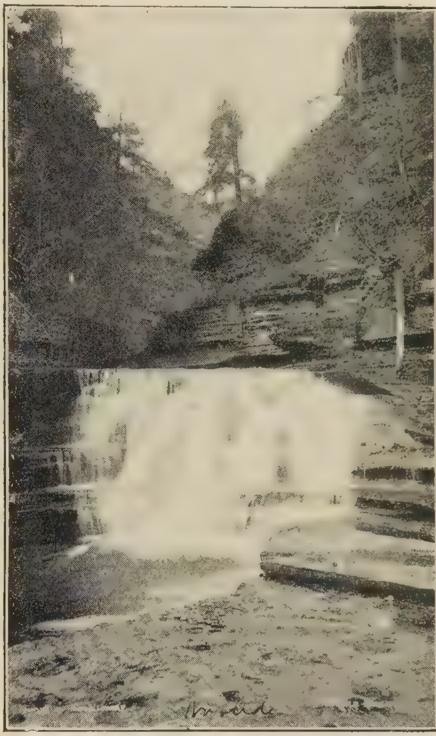

FIG. 13.—STEP FALL OVER SEVERAL HARD LAYERS, ENFIELD GORGE (MC GILLIVRAY, PHOTOGRAPHER).

INTERGLACIAL (?) GORGES.—In central New York there are numerous gorges which are broader than the postglacial valleys and partially obscured by glacial till, showing that they were formed either during preglacial or interglacial times. This class of valley is especially well illustrated in Six Mile Creek, where its relation to the broad, mature preglacial valley is well shown (Fig. 15). In one case near Taughannock valley, lake beds containing fresh water fossils have been found beneath the till.

Space forbids a discussion of this subject, since the exact origin of these gorges is not yet determined. When studies have reached over a wide enough area, the question of their distribution and origin will be brought forward; but at this time only the fact of their existence is mentioned in the hope that it may reach the eyes of some

who are working on the physiography of the State where similar gorges exist. The question is a large one, and not to be settled by the study of a single valley. One naturally thinks of these gorges as being interglacial in origin, and this explanation seems at present the most probable; but all that can now be said with certainty is, that they antedate the last advance of the ice. The question of these gorges has a very important bearing upon the whole subject of the drainage history of central and western New York.

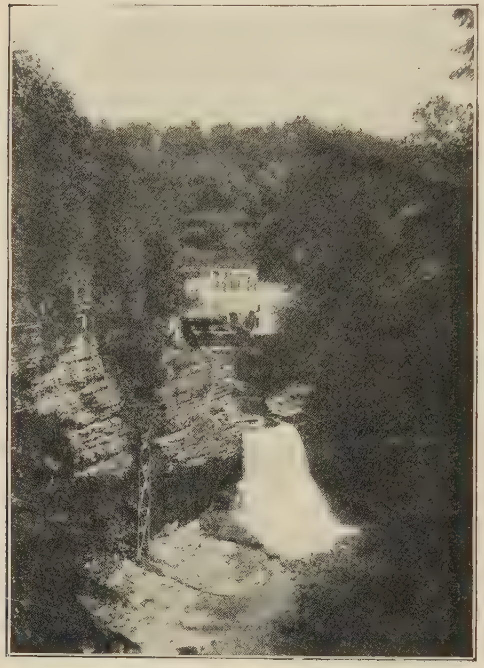

FIG. 14.—TRIPHAMMER FALLS IN FALL CREEK ON NORTHERN BOUNDARY OF CORNELL CAMPUS.

FORMER CONDITION OF THE FINGER LAKE VALLEYS. — Much has been written upon the origin of the Finger Lakes of New York.*

* Some of these refer to origin of Great Lakes. A complete bibliography of this subject will appear in a later number of this series. Vanuxem, Geol. of New York, 3rd Dist., 1842, 237; Hall, Geol. of New York, 4th Dist., 1843, 321, 405–6; Newberry, Proc. Boston Soc. Nat. Hist., IX, 1862, 42–46; Same, Annals New York Lyc. Nat. Hist., IX, 1870, 213–234; Same, II, 1874, 136–138; Same, Geol. Survey of Ohio, II, 1874, 72–80; Same, Proc. Amer. Phil. Soc., XX, 1882–83, 91–95; Simonds, Amer. Naturalist, XI, 1877, 49–51; Same, Amer. Geol., 1894, XIV, 58–62; Foote, Notes upon geological history of Cayuga and Seneca Lakes, Ithaca, N. Y., 1877, 14 pp. (Thesis presented for the degree of doctor of philosophy at Cornell University, June, 1877); Shaler & Davis, Illustrations of the Earth's Surface, Boston, 1881, p. 52; Davis, Proc. Boston Soc. Nat. Hist., XXI, 1882, 359–361; Same, 1882–83, XXII, 19–58; Spencer, Proc. Am. Phil. Soc., XIX, 1881, 300–337; Same, Amer. Geol., 1894, XIV, 134; Johnson, Annals New York Acad. Sci., II, 1882, 249–266; Chamberlin, 3rd Ann. Rept. U. S. Geol. Survey, 1883, 353–360; Wright, The Ice Age in North America, 3rd Ed., 1891, 323; Same, Man and the Glacial Period, 1892, 94; Lincoln, Amer. Journ. Sci., XLIV, 1892, 290–301; Same, XLVII, 1894, 105–113; Same, New York State Museum, Rept. 48, Part 2, 1894, 60–125; Brigham, Bull. Amer. Geog. Soc. XXV, No. 2, 1893, 1–21; Tarr, Bull. Geol. Soc. Amer., V, 1894, 339–356; Same, Amer. Geol., 1894, XIV, 194.

There is uniformity of agreement that they represent preglacial valleys, and the later workers are agreed that they represent preglacial valleys in some of which, at least, the streams flowed northward. There is a further agreement that they have been transformed to lakes by glacial action, though there is no agreement as to the exact cause for this change. It seems certain that at least Cayuga, Seneca, and the larger valleys to the west of these, which now enter Lake Ontario through the Oswego, had a more direct course to the lakes in preglacial times. As early as 1843 Hall suggested* that, prior to the formation of the Cayuga marshes, the outflow of Lakes Cayuga and Seneca was into the Ontario valley, through Port Bay. North of the Finger Lakes there is a broad valley transformed to a bay, which seems very likely to be the preglacial continuation of one or several of these valleys, though now choked with an extensive accumulation of drift, some of which is in the form of drumlins, through which the Seneca River now finds its way in a winding course. This region is so drift-filled in places that there is no surface sign of a preglacial valley.

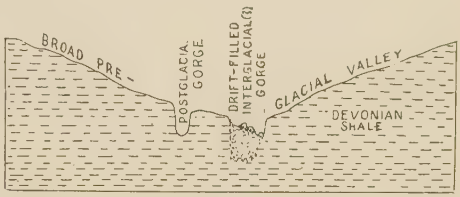


FIG. 15.—CROSS-SECTION OF SIX MILE CREEK SHOWING PREGLACIAL, INTERGLACIAL (?) AND POSTGLACIAL VALLEYS.

With reference to the cause of the transformation of the north-south valleys to lakes there are two opposing explanations. One is that they are clogged with drift, the other that they are gouged out by ice erosion. In all probability the true explanation is a combination of these two. The erosion theory, as a partial explanation of the depth of these valleys, was proposed in 1892 by Lincoln † and for Lake Cayuga in 1894 by myself.‡ The conclusions stated in my earlier paper have stood the test of much more extended studies, so that, after four years, I am even more fully convinced that the two larger lakes owe their depth below the lake surface in large measure to ice erosion, and that they are in the nature of rock basins. Additional facts have been brought to light in support of this theory, and none opposed to it. The only modification of the original proposition is that coming from the study of the supposed interglacial gorges; and since these are not now fully

* Hall, Geol. of New York, 4th Dist., 1843, 415.

† Lincoln, Amer. Journ. Sci., 1892, XLIV, 290–301.

‡ Tarr, Bull. Geol. Soc. Amer., V, 1894, 339–356.

understood, it is impossible at present to state just what this modification will be.

Therefore, the explanation which I shall put forward for the Finger Lake valleys is that there existed here several north-flowing streams, occupying preglacial valleys, some of which united and entered the Ontario stream somewhere north of Lakes Cayuga and Seneca. Without doubt some of the smaller of these Finger Lakes have been formed almost, if not entirely, by glacial deposits; but the two largest have their origin only in part as the result of glacial dumping. They offered broad channel ways, along which the

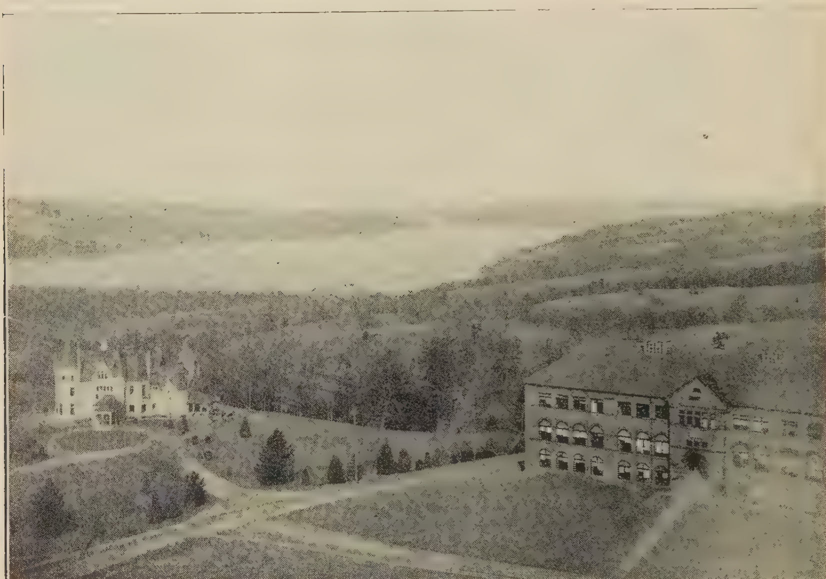

FIG. 16.—VIEW OF THE LAKE CAYUGA VALLEY FROM THE CORNELL CAMPUS. A BROAD PREGLACIAL STREAM VALLEY BROADENED AND DEEPENED BY GLACIAL EROSION AND NOW OCCUPIED BY A LAKE.

ice stream moved much more easily than upon the neighboring irregular hilltops. Not only was the movement more rapid, but the depth of the ice was greater. The position of the rocks, dipping southward, and the nature of the friable shales, conspired toward rapid erosion; and so these north and south preglacial valleys were markedly deepened.

Evidence of this comes from the side streams. The rock bottoms of the preglacial valleys of these tributary streams are not now below the level of the lake water in the southern part of the valley. If all the drift could be removed, and the streams be allowed

to flow along the line of the course of the preglacial valleys, and enter the valley of Lake Cayuga as it now stands, excepting that it be robbed of water, they would tumble between three and four hundred feet in a distance of about a mile, commencing their sudden descent near the present lake margin, a most unnatural condition for mature tributaries near their mouths.

Another fact in support of this explanation, clearly seen since the paper referred to was published, is that, if the main Cayuga stream flowed at the level of the present lake bottom, some of the tributary streams, like Fall Creek, must now have a drift-filling of not less than a thousand feet at a distance of three miles from the lake, a depth of drift hardly to be expected, and greater than anything anywhere known.

THE MOHAWK RIVER.*—Very early, possibly as far back as the Palæozoic times, the Adirondack Mountain mass evidently stood as a highland area, shedding water in several directions, and perhaps radially in all directions, as it does now. Some of these streams, flowing northward and westward, entered the Laurentian River, whose course determined the location of the Ontario Valley.

Judging by the history of the region, it seems exceedingly improbable that the Mohawk then had the course which it now follows. There are various reasons for believing that this river has developed its present course only after a long and complex history. It stands now as a notable topographic feature, a trench in the land in places over fifteen hundred feet deep and from twelve to twenty miles wide.† And it offers some evidence of this history.

According to Brigham ‡ the original Mohawk located itself on the southern side of the Adirondack Mountain mass, eating westward by headwater erosion as far as Little Falls. It was essentially a monoclinal valley, following the boundary between the Palæozoic and massive Archean rocks. Another river, flowing westward, and entering the Ontario Valley, called by Brigham the Rome River, disputed with the Mohawk for territory with its headwaters also at Little Falls.

The first evidence of this is found in the fact that the Mohawk narrows up to a gorge at Little Falls, somewhat as the Allegheny

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* Vanuxem, Geol. of New York, 3rd Dist., 1842, 20–21, 203–211; Dana, Amer. Journ. Sci., Ser. II, XXXV, 1863, 243–249; Darton, State Museum Rept. 47, 1894, 603–623; Same, Rept. 48, Part 2, 1895, 33–53; Same, Geol. Survey New York, 1896, 14th Annual Report, 33–56; and, particularly, Brigham, Bull. Geol. Soc. Amer., IX, 1898, 183–210.

† Brigham, Bull. Geol. Soc. Amer., IX, 1898, 183–210.

‡ Bull. Geol. Soc. Amer., IX, 1898, 186.

does at Thomson's Gap (p. 379), while west of this gorge, the valley again broadens, indicating that Little Falls is a divide region. This was early suggested by Chamberlin * and has been confirmed by the careful studies of Brigham,† who points out that this divide was determined by faulting at Little Falls, as the result of which the more resistant rocks at this point had been brought up nearer the surface than elsewhere in the valley. The proof of this position, so clearly suggested by the topography, and which has occurred to many travellers in passing through the Mohawk on the railroad, is the same as that brought forward by Carll for the Upper Allegheny (p. 379), namely, well-borings proving that the rock valley bottom west of Little Falls slopes westward, although the stream itself is now flowing eastward upon drift deposits. The rock floor slopes from an elevation of 376 feet at Little Falls to 347 at Utica and 220 at Sylvan Beach at Oneida Lake. The drift-filling is frequently more than 150 feet.

The Little Falls divide was lowered somewhat by glacial erosion, and then by the glacial water at the time that the Great Lakes were forced to overflow through the Mohawk Valley. At this time, while the divide was being lowered by water action, the headwaters of the present Mohawk were being filled with sand and gravel, since they were occupied by lake waters with an overflow at Little Falls. The divide has been still further lowered by the postglacial cutting of the western stream added to the original preglacial Mohawk.

According to this interpretation, the proof of which seems complete, the falls and rapids of the Mohawk, which have been so important in determining the site of several towns and industries, have been caused first by the production of faults, probably at the time of the Appalachian uplift, which raised the harder underlying rocks, so that they might serve as a divide because of their greater power of resistance, and, secondly, by the influence of the glacier in combining two streams flowing in opposite directions into a single stream, the present Mohawk, causing the upper part to flow across the old divide. This glacial accident has had an important influence upon the entire history of New York State, for, by building up the present grade of the Mohawk, it made the project of the construction of the Erie Canal far more feasible and less expensive than it would have been had it been necessary to *rise over* the divide at Little Falls, instead of *passing down* a fairly uniform and moderate

* 3rd Ann. Rept. U. S. Geological Survey, 362.

† Bull. Geol. Soc. Amer., IX, 1898, 183–210.

slope, mostly over soft glacial and lacustrine, and possibly, in part, marine deposits.*

The Hudson River.—The Hudson is divisible into two quite different parts: (1) the navigable section, from its mouth to Troy, which is in reality an estuary reached by tide water, and (2) the section from tide-water upstream, where it is a small but normal river, often interrupted by falls and rapids. In these respects the Hudson is like all the rivers that enter the ocean in the northeastern part of the continent, excepting that, in the case of the Hudson, the estuarine part is relatively longer and narrower than in the case of most such streams.

It takes but little study of this and other similar valleys to see that the upstream portion, above the tidal section, is the same in origin as the part occupied by the tide. They are in both cases valleys of erosion, and the occupation of a part of the valley by the tide water is due merely to the sinking of the land which has allowed the sea to enter the valley, as it would enter any land valley of the present if the land level should sink far enough. The valley has been partly drowned, and the river may be said to be a drowned river near its mouth. There is other evidence than that of the land topography that this is the true explanation.

When the Hudson River began its course is not certain. It now cuts across formations of different kinds, some of them representing the very roots of planed-down mountains, formed as far back as the Silurian time.† It is evident that the river did not originally have such a course as to have allowed it to cut across mountain chains. Professor Davis‡ believes that the Hudson valley lowland, on either side of the narrow trench now occupied by the river, was excavated during the Tertiary times, being begun upon a broad peneplain of Juratrias-Cretaceous origin, and hence having its course determined by the irregularities of this plain rather than by the attitude of the markedly folded rocks out of which the peneplain had been formed by long denudation.

An alternative view is that the broad valley which had been formed here in the course of time was then submerged beneath the sea, either in Triassic or Cretaceous times, and later being raised to form dry land was occupied by a river whose course was determined by the deposits made in the arm of the sea. Such a river course, which would

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* Taylor, Am. Geol., 1892, IX, 344; Upham, Same, 410.

† Tarr, Bull. Amer. Geog. Soc., 1897, XXIX, 26–31.

‡ Proc. Boston Soc. Nat. Hist., XXV, 1892, 318–335.

be said to be a superimposed course, would not necessarily be in accord with the attitude of the rocks, but might readily cross mount-

FIG. 17.—THE CATSKILLS AND MIDDLE HUDSON RIVER VALLEY SHOWING BREADTH OF VALLEY (PHOTOGRAPH OF MODEL BY E. E. HOWELL, WASHINGTON, D. C.).

ain folds. No proof of either of these hypotheses has been brought forward, and they therefore can be offered merely as suggestions as to the possible cause for the location of the Hudson here; and it


FIG. 18.—MODEL BY E. E. HOWELL OF LOWER HUDSON VALLEY AND NEW YORK BAY.

should be stated, furthermore, that these two suggestions do not exhaust the number of possible hypotheses.

Whatever the origin of this peculiar course, the Hudson seems to have begun the formation of the prominent features of its present valley in the Tertiary time, when the land was uplifted before the glacial period. Since this uplift was greater in the north than in the south, the valley was cut more deeply in the north; and where the rocks are soft, as above Newburgh, the valley is wide, while where they are harder it is narrow.* As a result of late Tertiary, or possibly post-Tertiary uplift and erosion, the river has cut a trench in this lowland a mile or more in width and of unknown depth. This trench, or gorge, is the valley of the Hudson which one sees in passing up the river; but to see its real relation to the broader valley one must leave the gorge and look across the valley from the high ground at one side, as for instance from the eastern slopes of the Catskills (Fig. 17). The Hudson valley is then seen to be a double valley, very broad and gently sloping, for the most part, and traversed by a narrow trench of unknown depth cut in the bottom of the broad valley lowland.

This inner, later gorge valley of the Hudson is of marked interest. It is up this that the tide waters extend; and therefore its bottom is now below sea-level. Since this gorge is the result of carving by river water, this fact proves that the river trench was cut at a time when the land was higher above sea-level than at present. This being so, one would expect to find a continuation of the valley beyond the present coast line along the sea-bottom plain of the continental shelf. As has been shown by Lindenkohl †, there is a channel extending to a distance of 105 miles from New York, having a width of a mile or two and a depth of 2,400 feet. It reaches to the very edge of the continental shelf, where it is indicated by a deep and rather narrow gorge. There are similar drowned river valleys off the New England coast, and near the mouth of the St. Lawrence, indicating a former general elevation of the north-eastern part of the continent.

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* These statements are based upon Professor Davis' discussion of the valley, Proc. Boston Soc. Nat. Hist., XXV, 1892, 318–335. See also Davis, Bull. Geol. Soc. Amer., II, 1891, 570–571.

† United States Coast Survey, Annual Rept. for 1884, 435–438 (This channel is mentioned by Newberry, Ann. New York Lyceum Nat. Hist., IX, 1870, p. 221, and also Popular Sci. Monthly, XIII, 1878, 641–666); Same, Amer. Journ. Sci., 1885, Ser. III, XXIX, 475–480; Same, XLI, 1891, 489–499; Dana, Amer. Journ. Sci., Ser. III, XL, 1890, 425–437; Upham, Bull. Geol. Soc. Amer., I, 1890, 563–567; Same, Proc. Amer. Assoc. Adv. Sci., XLI, 1892, 171–173.

During the time of the formation of this submerged valley, the Hudson must have received as tributaries some of the rivers of New Jersey and Connecticut which now enter the sea independently, and possibly the Connecticut itself. So the drowning of a portion of the land has dissected the stream system in its lower portion.

During the glacial period, the broad Hudson valley lowland was scoured by ice erosion, for it formed a trough down which the ice could easily move. Also, when the ice left the region, the land stood lower than at present, and the sea extended through the Hudson to the St. Lawrence, through the valley of Lake Champlain, thus making New England an island. The evidence of this is abundant and conclusive, for the valleys of the St. Lawrence, Lake Champlain, and the Hudson, contain clay deposits, often bearing marine fossils; and river deltas on the valley sides exist opposite the mouths of the streams.* The sea reached up the valley of the Mohawk, and some think that it passed even over the divide at Little Falls, as far as Lake Ontario, making the Adirondacks also an island. In some parts of the valley the deposits do not contain marine fossils; but this cannot be taken as evidence against marine origin, for the water may have been freshened by the addition of large quantities of ice-furnished water.

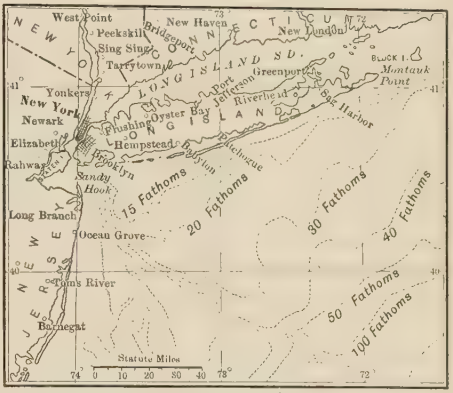


FIG. 19.—MAP OF SUBMERGED HUDSON RIVER VALLEY ON COASTAL SHELF OFF NEW YORK (AFTER DANA).

According to Merrill the depression was greater in the north than in the south, amounting to 340 feet near Albany, and about

* Hale, Amer. Journ. Sci., 1821, III, 72–73; Finch, Same, X, 1826, 227–29; Mather, Geol. of New York, 1st Dist., 1843, 129–150; Emmons, Same, 2nd Dist., 1842, 422–427; Ramsay, Quart. Journ. Geol. Soc., XV, 1859, 211–212; Hitchcock, Geol. of Vermont, Vol. I, 1861, 152–191; Same, Proc. Amer. Assoc. Adv. Sci., 1870, XIX, 175–181; Dwight, Trans. Vassar Bros. Inst., III, 1884–5, 86–97; Merrill, Amer. Journ. Sci., XLI, Ser. III, 460–466; Davis, Proc. Boston Soc. Nat. Hist., XXV, 1891–92, 318–335; Ries, 10th Rept. New York Geological Survey, 1890, 110–155; Same, Trans. New York Acad. Sci., 1891, XI, 33–39; Turner, Bull. Phil. Soc. of Washington, XI, 1891, 385–410; Taylor, Amer. Geol., 1892, IX, 344; Upham, Same, 410; Darton, N. Y. State Museum Rept., 47, 1894, 453–455; Nason, Same, 459–468; Brigham, Bull. Geol. Soc. Amer., IX, 1898, 183–210.

80 feet near New York; and this conclusion is in harmony with the evidence from other sections of the country. The reasons for the difference in elevation of the beaches and deltas of the Hudson valley, as elsewhere on the continent, is that the postglacial uplift, which has raised the deposits above the sea, has been greater in the north than in the south.

Other Rivers.—Little else has been written about the rivers of New York; but there are some points of interest in the articles mentioned below. Emmons * describes Glens Falls; and, in the same report, briefly discusses other rivers in his district, as do also Hall, Vanuxem and Mather in their reports on the geology of New York State. An interesting case of glacial diversion in the Bronx River is described by Kemp, † and some of the valleys of the Adirondacks are explained by Kemp. ‡

As shown by Darton,§ the headwaters of the Kaaters Kill and Plaaters Kill in the Catskills are exceedingly peculiar. The tributaries enter in barbed fashion, pointing up stream, instead of down stream, as they should normally. It looks as if they were tributaries to a west-flowing stream, instead of east-flowing; and Darton's suggestion is that they originally did flow westward into a stream which the Kaaters Kill and Plaaters Kill have been beheading by headwater erosion. This river capture of headwaters may well be expected here, for the Kaaters Kill and Plaaters Kill have steep, short slopes to tide water, while the streams with which they are in combat have a longer and less steep slope. It is one of the best cases of headwater conquest so far presented.

Lewis ‖ points out that the short streams on the southern side of the Long Island moraine, where they flow over the overwash gravel plains, have steep banks on the western side and flow in a direction slightly south of west. A similar condition has been shown to exist elsewhere where rivers are flowing in shallow trenches in soft deposits, and the peculiarity has been explained by the deflective effect of the earth's rotation, which, in the northern hemisphere, tends to turn moving bodies to the right. Lewis applies his explanation to the courses of the Long Island streams, and

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* Emmons, Geol. of New York, 2nd Dist., 1842, 188.

† Trans. New York Acad. Sci., 1896, 18. See also Britton, Trans. New York Acad. Sci., I, 1882, 181–183, and Brigham, American Geologist, XXI, 1898, 219–222.

‡ Bull. Geol. Soc. Amer., 1892, VIII, 408–413.

§ Bull. Geol. Soc. Amer., 1896, VII, 505–507; See also Julien, Trans. New York Acad. Sci., I, 1881, 24–27.

‖ Amer. Journ. Sci., Ser. III, XIII, 1877, 215–216.

Gilbert,* after considering the question, accepts this explanation.

Caverns.—During the course of stream development, in a region of limestone rocks, some of the drainage, finding its way underground, dissolves the limestone, and carves underground channels, which in some cases become true underground streams, possibly miles in length. Nowhere in New York is the development of limestone beds sufficient for the formation of extensive underground courses; but there is some limestone, and in this, one would expect to find such drainage.

The caverns so formed are naturally superficial, for the flow of water in them is determined by the level of the outflow, which itself is governed by the surface streams. Naturally, then, some of the underground channels have been destroyed by erosion in the glaciated region. Others have no doubt had their inlets or places of outflow clogged with drift, so that they are not easily seen; and still others, as in any limestone region, have not yet been discovered. But a few such underground channels, such as Howe's Cave, have been found and are visited.† They are not highly ornamented by stalactites and stalagmites, and do not compare in importance with the caves in other regions of the United States, where limestone strata are extensively developed.

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* Amer. Journ. Sci., 1884, Ser. III, XXVII, 427–432.

† See, for instance, Shepard, Amer. Journ. Sci., XXVII, 1835, 368–370; Gebhard, Same, XXVIII, 1835, 172–177; Mather, Geol. of New York, 1st Dist., 1843, 109–113, 637; Eggleston, Amer. Journ. Sci., Ser. II, I, 1846, 434–435.

## EXPLORATION OF CENTRAL ALASKA.

No better evidence could be had of the stability of our Government than the calm indifference with which, during the past summer, all its functions were performed and the plans of its various departments executed in apparent obliviousness of the state of war then existing. While the attention of the public was concentrated on the all-absorbing progress of the war, other events were occurring which at another time would have attracted considerable attention. One of the most notable series of exploring expeditions undertaken within a generation by the United States was successfully commenced and concluded, and that in spite of the demands upon the Government created by the war.

In March last Congress made an appropriation for the exploration of Central Alaska, to be conducted by the U. S. Geological Survey, and another appropriation for the conduct of a somewhat similar expedition by the War Department, the object being primarily to determine the limits of the gold deposits, and incidentally to examine into the other economic resources of Alaska, as well as to ascertain the practicability of building railways and highways within our territory.

Owing to the late date at which both appropriations were made, these expeditions were necessarily prepared in great haste and sailed for Alaska during the first week in April. Yet in spite of the shortness of the time few such enterprises have been better equipped or more successfully prosecuted. The outbreak of the war interfered materially with the expeditions sent out by the Army. Fortunately, however, each of these had attached to it a geologist of the U. S. Geological Survey, and these men with the remnant of the Army expeditions were able to continue their explorations.

In all, six overland exploring parties entered Alaska during the spring, in addition to a large force sent by the U. S. Coast and Geodetic Survey to map the entrance to the Yukon River near St. Michaels. The two Army expeditions consisted of troops from Vancouver Barracks and the two geologists, Messrs. Mendenhall and Schraeder. These parties were landed at the mouth of the Copper River and started out, one going northerly and the other northeastwardly toward the Yukon River. The work of these parties was arranged in co-operation with that of the U. S. Geological

Survey in such manner that the topographic and geologic results of each should supplement those of the other.

The U. S. Geological Survey sent out four expeditions. As shown on the accompanying route map, two of these were to start from the head of Cook's Inlet on the south coast of Alaska and travel, one northeastwardly and the other northwestwardly to the Yukon, and were to rendezvous at St. Michaels in the early fall. The other two were to take the customary route from Skagway over White Pass and down the Yukon. One of these was then to start in near the mouth of White River, cross to the headwaters of the Tanana and down it to the Yukon, rendezvousing with the others at St. Michaels. The fourth, instead of making an exploratory survey of the route traversed, like the other three, was to continue on to Circle City, there to make a detailed topographic and geologic survey of an area of a couple of thousand square miles.

Each of these parties consisted of a geologist and a topographer, one or other being in charge according to his rank in the force of the Geological Survey, and, in addition, there were from four to six laborers to pack the outfits, row boats, etc. These parties were peculiarly well equipped for their work both in personnel, instruments and supplies, and neither thought nor money was spared in outfitting them in such manner as would increase the chances of success. As a result of this, and in spite of the hardships and difficulties which were encountered in travelling overland in so inhospitable a country, all accomplished satisfactorily the tasks allotted them, and without delay or loss from sickness or serious mishap.

The task set these parties was stupendous. Compared with it the usual journey of the gold seeker of the Klondike was but a summer pleasure jaunt. The miner travels over well-known routes up the Yukon River, or over trails and down streams so thickly inhabited that he is rarely out of the sight of his fellow prospectors. The Government exploring parties, however, followed no beaten path, neither had they placid and well-known streams to navigate. Each plunged at once into the unknown interior, making its way in a specific direction, yet over great mountain ranges and trackless wastes for distances of six hundred to seven hundred miles each between the starting point and the Yukon. After arrival at the latter they had still hundreds of miles of boating to the end of the Alaskan journey at St. Michaels.

For transportation they took specially designed canoes, so light as to permit of being carried from one navigable stream to the next, and all bedding, provisions and instruments were transported in

these or packed on the backs of the members of the parties. When it is realized that most of the smaller rivers of the inland are shallow streams, filled with rocks, rapids and cataracts, travel by boat is reduced to anything but a certainty. Where walking was resorted to there were neither roads nor trails to make the task easy, but the bearers of the burdens had to fight their way over rugged mountain slopes covered with masses of loose rock, the crevices between which were hidden with a soft depth of treacherous moss, or perhaps fallen timber or dense underbrush, or forbidding glacier and snowbank barred the way at every step. Finally, the explorers were wet much of the time from rain, mist or frequent fordings of unbridged, icy streams, up which they frequently waded, towing their boats for hours at a time.

The entire expedition was originally under the immediate direction of George H. Eldridge, Geologist, but on their arrival at Alaska the parties separated, when the commander of each assumed independent charge. Mr. Eldridge was accompanied by Robert Muldrow, Topographer, and his party was landed at the head of Cook's Inlet by the U. S. gunboat *Wheeling*. Thence they boated up the Sushitna River to near its headwaters, whence they worked northeastwardly to the mountain divide separating that river from the Tanana. The original plan was that this party should continue down the Tanana to the Yukon and St. Michaels, but the difficulties encountered were such, and the mountain range crossed was so forbidding, that the journey down the Tanana being unnecessary because of its being made by another party, Mr. Eldridge returned by the same route as that on which he entered. This party found that but a short distance from the head of Cook's Inlet the Sushitna was divided into several large rivers, notably the Chulitna, which appeared to be the main stream, and the Yantna, both of which came in from the north and west, and the Sushitna, which bore off well toward the northeast. This latter stream they followed to its head and crossed over a divide of the elevation of nearly three thousand feet to the headwaters of the Tanana. The most notable discovery of this party was the location of a mythical mountain which they identified as Mt. Bulshaia, between the forks of the Chulitna and Yantna. The elevation of this mountain was determined to be a little over 19,500 feet, and, if this height is verified by office computation and the work of the second party, its position will be established as that of the highest mountain in the United States.

The second party was under the leadership of J. E. Spurr, Geologist, assisted by W. B. Post, Topographer. This party accom-

panied the first as far as the forks of the Sushitna, and made its way thence to the westward over the dividing mountain ranges to the headwaters of the Kuskokwim River, down which it floated on improvised rafts, crossing to the Yukon south of St. Michaels. As the members of this party completed their journey early in the season, they returned to the Kuskokwim at Oknagamut, down which stream they continued to the ocean and along the shore to Bristol Bay; there they ascended the Togiak River to Tikchik Lake. Thence they crossed the divide to Nogheling River and into Lake Clark and to their starting point on Cook's Inlet, before the close of navigation in the early winter.

The third and last exploratory party, under the direction of J. W. Peters, Topographer, who was accompanied by Alfred Brooks, Geologist, landed at the head of Lynn Canal at Skagway, thence it took the White Pass route via Marsh and Bennett lakes down the Lewis to the mouth of White River. Thus far this party and the fourth travelled together, their outfits being carried by the regular transportation companies. From near the mouth of White River, Mr. Peters' party ascended a small stream for two or three hundred miles, crossed the dividing mountain range and bearing off northwestwardly, made its way to the headwaters of the Tanana River, down which they travelled to its junction with the Yukon. Each of the three foregoing parties conducted a traverse or route survey, mapping at the same time as much of the adjacent topography as possible, while the geologists made a careful study of the economic resources of the region passed over, and photographs from which to illustrate the resulting reports.

The fourth party, under the direction of E. C. Barnard, Topographer, which entered Alaska by the same route as that of Mr. Peters, continued down the Yukon to the international boundary beyond Forty Mile. There they measured a base line, expanded a system of primary triangulation and completed a careful topographic survey of two thousand square miles of the territory adjacent to the east boundary of Alaska and the Yukon River, covering the more important gold fields in United States territory. This map will be published on a scale of 4 miles to one inch and in 200-ft. contours as one of the regular edition of topographic maps of the U. S. Geological Survey.

Each individual of the eight topographers and geologists was selected for his special fitness to perform the trying duties, not only of travelling an unknown wilderness, but of safely guiding and managing a party of men through the hardships they must encounter

and at the same time of satisfactorily conducting their surveys and examinations. All had had wide and varied experience in similar surveys in the most inaccessible portions of the Western United States and under the most embarrassing conditions which this country can afford. Mr. Spurr made surveys in the Yukon region in 1896 and was therefore tried in the duties which he had to perform. Messrs. Eldridge, Barnard and Peters had spent twelve to fifteen years each on Government surveys in the Appalachian Mountains, the Adirondacks, the deserts of Arizona, the Sierras of California, the Big Horns of Idaho and the Rockies of Montana. The others have had equally varied experience, but for shorter periods of time. The laborers or packers were equally experienced men. All were chosen from the best camp hands employed annually by the many field parties in the Geological Survey. They were the pick of the Adirondack guides and the Minnesota, Idaho and Washington woodsmen. The instruments taken were of the lightest and most portable design, and were carried in water-tight tin cases. All provisions were arranged in small, sealed tin or canvas packages to preserve them from moisture, and light sleeping bags completed the paraphernalia.

The two Army expeditions were equally successful in their results, but as they have not all yet reached the United States the full output of their labors is not known. The party under Captain Glenn started in at the head of Cook's Inlet and ascended the Matanuska River, which is the first important stream to the east of the Sushitna. From the headwaters of this stream they crossed over to the Copper River, where their route connected with that of Captain Abercrombie's party. The same party (that of Captain Glenn) crossed Kenai Peninsula, from the head of Cook's Inlet to Cape Resurrection on the ocean. A branch of this party continued north across Tanana River and the head of Birch Creek to Circle City where they will winter.

Captain Abercrombie's party started in at Prince William Sound, near the mouth of Copper River and crossed Valdes Glacier, where considerable hardship was experienced and a few lives are reported to have been lost. Continuing overland they reached the Copper River near the mouth of Liebigstag River and skirting the Copper River on the low ridges bordering its west shore, they continued to Mantasta Pass, whence they crossed to the Tanana River, intersecting the route taken by Mr. Peters, and continued on to the head of Forty Mile Creek, which was explored in 1896 by Mr. Spurr, of the U. S. Geological Survey, and down this they made their way to the Yukon.

Each Army expedition consisted of about fifteen men, including civilians and packers. Transportation was by pack animals and they proved most satisfactory adjuncts to Alaskan travel. No difficulty was experienced in subsisting the mules on wild feed, and all stood the hardships of the journey admirably, thus materially lightening the physical hardships of the men.

The routes of these parties were so planned in conjunction with the two Army expeditions up the Copper River as to completely gridiron with surveys the great Alaskan interior between the southern coast and the Yukon highway. From the time of their departure in April no word was received from any of these parties, as all were off the beaten track. It had been planned that they should reach St. Michaels about the middle of September in such time as to catch the last steamers for Seattle, and so well did they plan their movements that on the 7th of October, Messrs. Peters and Barnard reached Seattle from St. Michaels, bringing word that Spurr had been heard from and would arrive by a later steamer. Less than a week afterwards Eldridge's party reached Seattle from Cook's Inlet. All had successfully performed the duties assigned them, and as a result have added to our knowledge such a mass of information relative to the geography and resources of interior Alaska as will take that region forever from the realm of the unknown.

The party sent by the U. S. Coast and Geodetic Survey to map the hydrography at the mouth of the Yukon River, subsisted in one of the large vessels of the Coast Survey and had in addition a number of seaworthy launches for soundings and other hydrographic work. This party was under the general direction of Mr. J. F. Pratt, and while their field season was greatly curtailed because of the amount of stormy weather encountered, the results attained were most gratifying. They completed a Coast Survey chart of a large portion of the least known of the various bars and channels at the mouth of the Yukon, and the most important result of this chart was the discovery of a sufficient depth of water in one of the southernmost channels to permit the safe passage of ocean-going vessels. In consequence the trip by this channel shortens the distance between Yukon points and Pacific coast ports by several hundred miles. This party discontinued work in the late fall just before the closing to the navigation by ice, and returned to the Washington office to work up its results.

# ABORIGINAL ARCHITECTURE IN THE UNITED STATES.

BY

COSMOS MINDELEFF.

Architecture has been defined by Fergusson, perhaps the greatest of its historians, as "ornamented and ornamental construction." Under that definition the houses of that part of the American aborigines who inhabited what is now the United States have no standing; since they were strictly utilitarian and were neither ornamented nor ornamental. It is true that in the highest types of Pueblo houses we can detect the first faint glimmerings of that art whose presence, according to the definition, constitutes the difference between house building and architecture, but if we broaden the field a little and make the terms synonymous we find that the houses of the American Indians occupy a very important place in the history of architecture and present a phase of human activity which cannot be ignored in the study of that art.

Fergusson himself, some thirty years ago, lamented the absence of knowledge concerning the houses of the American aborigines, and complained that his great History of Architecture was incomplete because it lacked that one chapter. Even then the great temples of India, once so great a mystery, were better understood than the ruins scattered over the southwestern part of the United States and in Mexico and Yucatan. That chapter is not yet written, but year by year investigation and study have progressed, and eventually some master hand will gather together the vast amount of data which has been accumulated and will condense it into a few hundred printed pages. In the meantime we can get a glimpse here and there of the meaning of part, at least, of what we have.

More than twenty-five years ago Lewis H. Morgan, often named the father of American archæology, called attention to the false views then prevailing, and his work on "Houses and House Life of the American Aborigines" was the starting point of all later students. He referred particularly to the higher art of Mexico and Central America, which had always been discussed on the lines —picturesque but false—so ably sketched by Prescott in his Conquest of Mexico. The architecture of that region was interpreted through the glowing accounts of the Spanish conquerors, and the resulting exaggerated views have thrown a kind of reflected light on

the ruins found in New Mexico and Arizona. These deserted groups of well-built stone houses appealed to the imagination of the early explorers and were linked to the name of Montezuma and ascribed to the Aztecs. By others, the people who built them were regarded as a race apart, who were swept from the earth by some mighty catastrophe. The rank and file of the Navajo Indians, who now live in that country, have much the same idea: if you ask one of them what became of the "narcuzzi"—the people who lived in the ruins—he will tell you that a great wind arose and swept them all away. Fortunately the houses were left, and from a study of the ruins we can tell pretty closely who and what the people were. In Morgan's time all kinds of exaggerated accounts of the ruins were current, as some of them are to-day; but it was said then in one of the leading magazines that "In size and grandeur of conception they equal any of the present buildings of the United States, if we except the Capitol at Washington, and may without discredit be compared to the Pantheon and the Colosseum of the Old World."

At the present day these ideas have almost disappeared. We know that many of the ruins were occupied within the historic period; in fact, we can say that with a few exceptions we know of none which antedate that period, although there is a fair presumption that many of them did. We know that most of the old villages were inhabited by the ancestors of the Pueblo Indians now living in Arizona and New Mexico; that the old house-builders lived under much the same conditions that prevail to-day in that region; and that the cliff dwellings were merely an episode in their history. Knowing this, in the pueblo villages of the present we can study the ruins of the past.

Within the great area now known as the United States, there were at the close of the fifteenth century perhaps half a million Indians, divided into numerous tribes, each with its own habits and customs, and each building its own style of houses. Aside from the villages of the sedentary or pueblo tribes, few of these rose much above the rank of rude domiciliary huts, enlarged perhaps or slightly changed to form the religious edifices or churches of the people. Instead, therefore, of glancing over a list of perhaps a hundred different but rude types, let us look a little more closely at the highest and at one of the lowest classes, both found within the same region and subjected to the same geographic environment—the houses of the Pueblo Indians of Arizona and New Mexico, and the hogans or huts of the Navajos.

Although purely aboriginal in its origin, hardly less so in its

development, pueblo architecture affords one of the best examples in the history of art of adaptation to environment—to the physical characteristics of the country where it is found; and such adaptation to the country and to the life and wants of the people who practise it is the great principle underlying every school of architecture. There is no art which has the same value to the student of archæology and none which makes so clear a record of a people's life and aspirations as the art of house-building. The record is especially valuable because it is made unconsciously; certain wants are met in a certain way, or in a variety of ways, and the various attempts to meet the changing conditions are all crystallized and embodied, as it were, in the expedient which is finally adopted, so that each detail contains within itself a record of the steps which led up to it. This condition is found all over the world, as, for example, in forms employed in stone construction which were clearly first used in wood, and while well adapted to the latter are hardly suited to the former. Yet they survive year after year and far into the centuries through that conservatism in art which forms the second and not least important element in its development, for without the conservative or conserving element there would be no progress in evolution.

The complete adaptation to its peculiar environment displayed by the pueblo system of architecture shows that it has long been practised under the same conditions as those now prevailing; if not in the same region, then in one like it. It is the product of a primitive people, and like all such people the pueblo builders were and are now peculiarly sensitive to their physical environment and their topographical surroundings. They are truly children of nature and unconsciously put themselves in accord with natural conditions with a completeness and celerity, which is almost incomprehensible to a people whose lives are so largely artificial as our own. Upon such a people the materials supplied by nature are apt to exercise a larger influence on the house-building art than the ideas to which the material was applied.

The ancient pueblo culture was confined practically to the limits of the plateau province, covering perhaps 150,000 square miles in the southwestern part of the United States, and was absolutely dependent upon the peculiar geographic conditions found there. Hundreds of the old villages were constructed of the tabular sandstone found in natural quarries at the bases of the cliffs throughout that region. This stone breaks into small fragments of regular form suitable for use in the simple masonry of the pueblos, without

any labor other than the mere collection of the pieces. This abundance of material, acting in conjunction with certain social forces, prominent among which was the necessity for constant defence, has produced the many-storied hive-like villages which form one of the most picturesque features of New Mexico.

There are at present some eighteen inhabited villages scattered along the valley of the Rio Grande, and a dozen more in the west. Nearly all of them are located in the midst of broad open valleys. This type represents, however, the latest stage in pueblo growth, a stage reached by most of the tribes only within the historic period. Since the earliest times of which we have a record the Pueblos have been subjected to more or less pressure from surrounding wild tribes, who found in the villages convenient storehouses of food, and in the villagers a contemptible foe. It was under this pressure that the great valley pueblos were developed. But many of the earlier types can still be traced in the ruins, and some of them are still in use in the western part of the pueblo country.

From the great amount of data which have been collected it is now possible to form some idea of the sequence in development exhibited by the ruins, although it is impossible as yet to establish a chronologic order for the various types. It seems probable that in the early days of pueblo architecture small settlements were the rule. These were doubtless located in the valleys on sites most convenient for horticulture, each family or gens occupying its own little village. Incursions by neighboring wild tribes or by hostile neighbors gradually compelled the removal of these little settlements to sites more easily defended and also forced the various related families to band together. At a later period the same motive, emphasized perhaps, brought about a further removal to still more difficult sites and the villages were placed on the summits of almost inaccessible *mesas*, as in the case of the Moki village of Shipaulovi. At the time of the discovery by the Spaniards and their conquest of the country the Mokis lived in villages located on foothills of the mesas, and many other settlements occupied similar sites at that time. Soon after, the people moved to the tops of the mesas. Some of the villages were in this stage at the time of the discovery, notably the Pueblo of Acoma. Finally many villages whose people spoke the same language combined to form one larger settlement, which, relying now upon size and numbers for defence, was again located on the most convenient site, in the broad open valleys surrounded by fine arable lands.

Since New Mexico came into our possession and the pressure of

the wild tribes has been removed from the Pueblos the process has been much quickened, and the old mesa villages are being rapidly abandoned. Indeed, along the Rio Grande, where the settlements were near enough together to render mutual aid, the movement had commenced before 1846, and villages of quite small size were located in the open. The progress in this direction in the past few years has been very great, and in another generation the old pueblo architecture will be known only through its ruins.

The process which I have sketched was by no means continuous. The whole population was in slow migration, but not in the sense in which the term has been applied to European and Asiatic tribes. There was seldom a movement of the people in mass, but a constant although very slow change of base, generally without any definite end in view. Outlying settlements were established for the purpose of farming neighboring fields; these might be found more convenient than the parent village and would eventually surpass it in size and importance, only to be supplanted in turn by their own subordinate settlements. It was an unconscious migration. The tribe might move only twenty miles in three or four generations, or, on the other hand, it might move a hundred miles in a week. But viewed across the centuries the movement may be regarded as constant. It was this slow migration which produced the thousands of ruins scattered over New Mexico and Arizona. These have been used as a basis for estimating a former population of 250,000, or even half a million, although the Pueblos never numbered over 30,000, and there are now 10,000 of them. A band of 500 Indians might leave the remains of fifty villages in the course of a single century.

With the first concentration of scattered houses into villages a new element in pueblo architecture made its appearance. This is the summer shelter, occupied only during the farming season and abandoned for the home village on the approach of winter. This custom was brought about by the scarcity of good land and the difficulty of finding it near the home settlements. Thus many were compelled to go some distance away to carry on their farming operations. The slow migration referred to doubtless had its origin in this custom. The summer shelters form an invariable feature of pueblo life, ancient and modern. They are of various forms, but in function they are all alike. In Moki they are brush shelters; in Zuñi they are single rooms in old ruins maintained in good order while the rest of the structure sank to decay; under favorable geological conditions they become cliff ruins; under other circum-

stances they are cavate lodges. But in one form or another they are always found in connection with the permanent homes of the Pueblos.

The unit of pueblo architecture is the single cell, whether it occurs alone, as in the summer shelters, or in great masses like the huge structures which give shelter to 1,500 souls or more. Sometimes the cells are arranged not in clusters, but in long rows, as in most of the Moki towns. In such cases the houses are usually only one or two stories high. In Zuñi, the largest of all the pueblos, the houses occur in irregular groups and, as a rule, are two stories or more in height. Some of the Rio Grande villages are laid out on a similar plan. As none of the villages except Taos and Acoma now occupies the same site that it did when discovered some 350 years ago, they are in a sense all modern, and reflect modern rather than primitive conditions.

The old architecture has been much influenced by contact with the Spanish and afterwards with the Mexican population of New Mexico. The old plan of terraced construction, a characteristic of the pueblo system, is still apparent, the upper stories being set back from the lower in a series of receding steps or terraces, but the former requirement that the first tier of rooms should afford no opening on the ground has been done away with since the possibility of an onslaught by savage foes has been removed. Formerly the only means of access to the first terrace was by a ladder to the roof, thence by another ladder into the interior, and as these ladders were easily removed each house cluster was in effect a fortress. The terracing of houses reaches its greatest development in the villages of Taos, on the upper Rio Grande, and Zuñi, near the Arizona boundary. At one place in the latter it is possible to count seven stories by passing from terrace to terrace, but a plumb-line dropped from the roof of the uppermost one would pass through only four rooms to reach the ground.

As a rule the masonry of the eastern villages is covered with a finish of mud mortar, giving them a pleasant appearance, but conducing to poor stone work. In most of the large ruins found in that country no mortar was used upon the surface, but the stone itself was beautifully finished by pecking the surface and rubbing it down after the blocks were placed in position. The same method prevailed in some of the cliff ruins. The finest masonry in the pueblo region is found in the Chaco ruins, a group of old villages in northern New Mexico. Even there, however, the result was obtained by careful selection of material and not by skill in its use.

The best walls usually consist of an outer and an inner face with a rubble filling between. The Chaco ruins belong to the same class as the great valley pueblos, like Zuñi and Taos. In other words, they are the remains of important home villages, occupied at a time when the people were driven to abandon their smaller settlements and to congregate in large numbers for mutual defence.

The masonry of the ruins exhibits two distinct types. One consists of carefully selected stones of uniform size laid up in the manner already indicated. In other walls, or sometimes in other parts of the same wall, a beautiful face was obtained by the use of small spawls driven in between layers of selected stones not much larger in size. These walls have the appearance, at a little distance, of a fine mosaic. Occasionally the two systems are combined to form a peculiar banded construction. Here, in the highest type of masonry attained by the ancient builders, we have the birth of that architecture which was defined by Fergusson. In other words, here, for the first time, the old-time architect bethought him to make his construction ornamental, and he succeeded. There is an earlier stage in which the spawls were used only here and there, and appear to be a convenience or a use of old material on hand rather than a striving for an ornamental effect. Unquestionably this finely finished masonry must be ranked far above the plastered surface, no matter how well the latter may be done.

Perhaps the highest type of surface finish is that found in the Casa Grande ruin, on the Gila River in southern Arizona. The building was constructed of rammed earth and has a clear historical record of more than two centuries. Even so long ago it was in ruin, and not greatly different in appearance from what it is to-day. But although the interior walls have been exposed to the weather for more than 200 years their smoothness and fine finish attract the attention of all visitors to-day, as they attracted that of the first Spanish chronicler, who wrote of them, "The walls shine like Pueblo pottery." Just how this durable and fine finish was secured is a mystery which many American builders in that country would like to solve. The exterior walls were not so protected. They are much worn and seamed by the weather and have been undercut at the ground level to a depth of two feet or more. When the ruin was repaired under my direction, some years ago, I took measures to prevent this weathering, but the inner walls I left just as they were, and they will certainly last a generation or two, if not a couple of centuries, longer.

In the inhabited villages of the West the masonry is usually

rough, but the old system of building is much more closely followed. In the Moki villages openings in the first tier of rooms giving directly upon the ground are comparatively rare, and the number of ladders in use is correspondingly increased. These ladders are used everywhere, not only by the men and women of the village, but even by little children who are hardly able to walk, and by the dogs, of which there appear to be a dozen, more or less, for every man in the place.

The building of a house is not such a simple affair as might be inferred from the finished product. Descent and inheritance are in the female line. In fact, the women own all the property save a few personal belongings of the men and their horses. The women, therefore, build the houses, but a house building is always made a social occasion, much like the log-raising of our early days, when the frontier was on this side of the Ohio River. Female friends from far and near gather to take part in it, and usually a man or two of the family is impressed to do the heavy work.

When the material has been brought to the site and everything is ready the priestess of the clan must be notified, and an announcement to the neighbors is made from the house tops by a crier. The chief of the village provides four eagle feathers with a short cotton string attached to the stem of each. These are sprinkled with sacred meal and prayers are breathed upon them for the welfare of the occupants of the house, and that the walls may take firm hold upon the ground. The feathers are laid at the four corners of the house and a large stone is placed over each one. The place where the door is to be is marked by bits of food on each side of the opening, this ceremony being accompanied by prayers to the sun that there may be always an abundance of food within. The lines where the walls are to be are marked on the ground by particles of bread and other food mixed with the native tobacco, the sacred plant. The women then proceed to lay up the walls. When the structure reaches a height of seven or eight feet the roof beams are put in place. These beams are often brought great distances, for suitable timber is not to be found everywhere. According to the Moki traditions the timbers used in the construction of the mission buildings erected in the 17th century were brought on the backs of men from the San Francisco Mountains, more than a hundred miles away. Some of them are still in use in native structures, (for the Mission buildings have long since disappeared,) and are still pointed out to the curious.

The roof beams are covered with smaller poles, and with brush

and grass, and are finished with earth, a mud floor is made inside and the walls are plastered with the same material, the whole being nicely smoothed by hand. Formerly a custom prevailed of leaving a small space in the wall bare, under the belief that one of the gods came and finished it. Although this spot remained as it was left, it was supposed to be covered with an invisible plaster. When the house is completed to this point four more feathers are prepared and tied to a short stick, which is inserted over one of the central beams. The feathers are renewed every year in December, when the sun begins to return northward; that is, at the winter solstice. The ceremony of "feeding the house" is then performed. This is an offering to the sun and consists of placing bits of food among the rafters, with prayers to the sun that he will not hasten the departure of any of the occupants to the underworld. A fire-place is then built in one corner and a bin-like arrangement containing three or four flat stones for grinding corn in another. The house is then ready for occupancy. The door is merely an opening closed by a blanket in cold weather. Rude as it is, the interior of a pueblo house is quite comfortable.

Oddly enough the ground plan of a village is dictated by the number of girls who live there. Not only do the women own all the property, but when a man marries he goes to the home of his wife and becomes an adopted member of her family. A family in which there are many girls must increase and multiply, and as house space becomes inadequate must build new rooms adjoining, while one in which there are only sons must become extinct in the next generation.

In its general outlines the pueblo system of architecture can be traced through its various stages, from the primitive earth lodges, like those in use by the Navajos, up to the many-storied clusters which mark its greatest development. The various steps have followed from a simple and direct use of such material as was immediately at hand, combined with conditions which compelled the frequent use of that material, among them the slow migration which was in progress in all the tribes, and the ever present necessity for defence against a strong foe. The results attained testify to the patient industry of the pueblo builders rather than to skill in construction, for the best walls which have been found are the result of careful selection of material only. It will be interesting now to look at the Navajos, who for many generations have lived under the same physical conditions.

A greater contrast than that between the puny and rather feeble

Pueblos and the athletic Navajos could hardly be found. Magnificent six-footers, living in the saddle from their earliest childhood, descended from a long line of freebooters and robbers who preyed upon all the surrounding tribes, the Navajos fear nothing save the anger of their gods or the ill opinion of their fellows.

Prior to our conquest of the country in 1846 they lived chiefly by war and plunder. The Mexican settlements along the Rio Grande and the Pueblo villages of the same region were the principal contributors to their welfare, and the thousands of sheep and horses which were stolen then formed the nucleus of the immense flocks and herds which constitute their wealth to-day. It took a long time to persuade the Navajos that a change in their methods of life must follow the new régime, and the war which followed was brought to a close only by a resort to the most drastic and barbarous measures on the part of our troops. The fields of the Indians were burned over, their orchards were cut down, and squads of soldiers were stationed at every spring and water hole to bayonet the sheep and horses that came to drink. Eventually the Indians were brought to terms, and we have had no real trouble with them since, although almost every year the troops scurry out into the Reservation to keep down some threatened outbreak.

The houses of these people are earth-covered huts, and as a rule each one stands by itself. They are usually so hidden away that a traveller who is not familiar with the customs of the Indians might journey for days and not see half a dozen of them, and he would be apt to get the impression that the country is practically uninhabited. He might hear the bark of a dog in the distance, or far away on the mountain side he might see a pillar of smoke like that rising from his own camp fire. Yet the tribe numbers more than 12,000 souls, and there was probably no time during the day when several pairs of eyes were not watching his movements. Were he to fire his gun the report would be heard by several hundred men. Probably this custom of partly concealing their habitations is a survival from the time when the Navajos lived in momentary expectation of reprisals on the part of their victims.

The hogans intended for permanent use are always constructed after a fixed pattern, no variations from which are permitted, although in the valleys it is often difficult to procure suitable timber. They are invariably built with an entrance made in the fashion of a dormer window. When the Navajos finally realized that they would not be allowed to plunder their neighbors they utilized the enormous flocks they had and became a pastoral people. Under

recent conditions they are becoming farmers and, like the Pueblos, they have developed the use of farming shelters, which are commonly half huts. The Navajos never congregate into villages, however, and the movement from the winter hut to the summer shelter is merely a change from one part of the country to another. Sometimes the summer shelters are merely rude shelters of cedar brush and logs. Sometimes they are regular winter huts in all respects save the final earth covering. But the summer houses can always be distinguished from the regular huts because the latter must and invariably do front the east, no matter if by so doing they look directly into the side of a hill. In fact, rude as the winter huts appear, every detail in them is dictated by an elaborate ritual and strict ceremonial requirements.

Among these Indians there are many myths and legends of wonderful houses built by the gods. In them turquoises and pearly shells were used, as were also the filmy mists of dawn and the gorgeous hues of sunset. They were covered with sunbeams, and rainbows, and everything beautiful in the earth and sky. In the construction of a hut to-day the door is invariably placed toward the east, in order to allow free access to the kindly influences of the God of Dawn. Each timber must be placed in its regular order and in a prescribed way, the neighbors and friends of each builder assisting in the construction.

A great change is now taking place among the Navajos, for, owing to the present conditions, they can no longer make a living from their flocks, and they are slowly but surely being forced to cultivate the land. The contrast between the passing and the rising generation is marked. Among other things the old hogans, with their elaborate ceremonial of dedication, are passing away, and are being replaced by houses modelled on the American plan. Such houses are a wide departure from the old ideas of the Navajos. They are rectangular in plan, sometimes with a board roof, and occasionally they comprise several rooms. In the mountain districts many of them are built of logs hewn square before being laid in place. Such houses render impossible the ceremonial of dedication, and the old rites are gradually falling into disuse.

The beliefs of the Navajos in regard to their dead for a long time prevented any departure from the ancient type. In the cañon country and especially where there are cliff ruins—which are regarded as sacred—the dead are placed in burial cists. These are generally constructed in a ruin. Out in the open country, comprising most of the Reservation, this is impracticable, and the hut

in which a man has died is pulled down over the remains and set on fire. After that nothing would induce a Navajo to touch a piece of wood from it, or even to approach the vicinity of the place. Even many years after they are able to recognize these *chindi hogans* or ghost houses, as they are called, and they carefully avoid them. This custom has much to do with the temporary character of the Navajo houses, for men are born to die and they must die somewhere. In recent years, however, the problem of how to build and retain more elaborate houses has been solved in a way which is simple but very satisfactory to the Navajos: when a man is about to die he is taken outside and allowed to breathe his last in the open air.

The remains of a Navajo hogan seem hardly comparable with the houses of the Pueblos, or even with the single-room remains which we call cliff dwellings. Some of the Pueblo tribes have been subjected to almost the same geographic environment as the Navajos, yet the house structures appear radically different. The Pueblo villages, however, are the direct outgrowth of just such lodges as the Navajos use, and the reasons why they have not advanced together lie principally in two causes—antecedent habits and personal character. With their habits as warriors and robbers, combined with their large flocks, which must be periodically moved from place to place, only temporary habitations were possible to the Navajos. On the other hand, most of the Pueblos came into the particular regions where they are found from other similar regions, where they had developed an elaborate system of house building admirably adapted to them. They were in no sense warriors, and all they asked was to be let alone. Dissimilar as the two peoples were, they would have come together had they been left undisturbed; in fact, they had already shown some signs of it, but the introduction of sheep by the Spaniards some 350 years ago emphasized the differences between them. The possession of sheep fell in exactly with the habits of the Navajos, but the pastoral life was impossible to the Pueblos, living as they did in fixed habitations from which they were afraid to venture far. They had sheep, which the Navajos periodically took away from them, but their main reliance for subsistence has always been on the cultivation of the ground. Under the strong arm of the Government, the two tribes are coming closer together. The most timid of the Pueblos are becoming more bold. They are gradually leaving their mesa fastnesses and are building individual homes in the valley below. Incidentally they are increasing their flocks and herds. On the

other hand, the Navajos are slowly taking up agriculture and show some disposition to form communities. Their flocks are decreasing and in a few years will no longer dictate the habits of the people. But as a house builder it is the old Navajo and not the Navajo of to-day who interests us.

In the vicinity of nearly every hogan will be found a primitive loom, upon which the woman of the house weaves the elaborate and gaudy blankets which have recently become an article of barter with the traders. Oddly enough, among the Pueblos the men are the weavers, but among the Navajos a woman is valued almost entirely for her skill in weaving, for blankets are a not inconsiderable asset of a household, and wool which is sold for five cents a pound readily brings forty cents when made into blankets. Not infrequently a loom is set up at some distance from the hogan, perhaps between two trees which are spaced about the required distance apart. Here the women live for a month or more at a time while an elaborate blanket is being made, the lord and master of the house in the meantime going off on a visit to his friends. Although marriage in the tribe is by purchase and a woman is bought from her family for so many horses, the rules of property obtain in her case as in that of the Pueblo women. Everything belongs to her except the horses and cattle. Not even a sheep can be sold to a passing traveller without her consent, and when sold the money received must be handed to her.

It is the medicine men who conduct the dedication of the hogans. This ceremony is regarded as having a very solemn significance by the elders of the tribe, although considered by the young people as principally an occasion for merry-making, as was the old Anglo-Saxon house-warming. It is believed that unless the rites are observed soon after the house is completed, bad dreams will plague the dwellers therein, toothache will torture them, their flocks will dwindle, ghosts will haunt the place, and the house will become tabooed, a place of evil. Accordingly, a few days after the house is built, arrangements are made with a medicine man to come and sing the house songs. For this he receives a good fee. Seating himself so as to face the doorway and the east, he sings a number of songs addressed to all the cardinal points, for in the Navajo system different groups of deities are assigned to each of them. This ceremony is known as the twelve songs, although in fact there are only two of them, each repeated twelve times. He prays for "male rain," such as accompanies thunder-storms, and for "young rains" or showers coming directly from the east. Both are regarded

as necessary to fertilize the soil. He prays also that the house may cover many "hard possessions," such as turquoise, coral and silver, and "soft possessions," such as blankets and buckskins. The ceremony, which commonly begins at nightfall, is prolonged by invocations to the sun and to the dawn, to the twilight, to the light and to the darkness, to the six sacred mountains, and to numerous other deities. Invocation is also made to evil things, to coughs and lung troubles, to the sorcerers, and to others, beseeching them to keep away. The whole ceremony is so timed that it is completed just as the first grey streaks of dawn appear, when the visitors get up their horses and ride home.

# RECORD OF GEOGRAPHICAL PROGRESS.

## AMERICA.

RAIDS OF THE ONAS ON FLOCKS IN TIERRA DEL FUEGO.—Dr. H. Polakowsky writes in the *Verhandlungen* of the Berlin Geographical Society (No. 7, 1898), that the remnant of the aboriginal Onas living in the Chilian portion of Tierra del Fuego are about to be removed to the Dawson Island because they have killed several Chilians and, driven by hunger, have made war upon the sheep herded there which they call "White Guanacos." The Guanacos which were formerly in great numbers in Tierra del Fuego were the mainstay of the natives for both food and clothing.

HIGHEST KNOWN POINT OF THE WESTERN WORLD.—Mr. E. A. FitzGerald in his paper read before the Royal Geographical Society (*Geog. Jour.*, Vol. XII, No. 5) says that the summit of Mount Aconcagua, a little east of the boundary between Argentina and Chile, and which, as far as is known, is the culminating point of the Americas, is a square plateau 75 paces each way, sloping at an angle of 7° towards the north. When his party visited it last year the summit was entirely free from snow. The western and northwestern sides of the mountain fall away at an angle of 20° and present long slopes of loose stones which are kept clear of snow in summer by the winds that sweep them. On the south and southwest the sides are more precipitous and also fairly clear of snow and ice; but on the southeast there is an enormous precipice of nearly 10,000 feet covered with great overhanging masses of snow and ice, forming a very imposing spectacle.

To the northwest the line of the Pacific was in view stretching away for over 150 miles. Range after range of mountains could be seen between Aconcagua and the ocean. Nothing could be seen of the pampas of Argentina, too many ranges of high mountains intervening. To the south there was a fine view of Tupungato, fifty miles away and about 22,000 feet high. At the time Mr. FitzGerald read his paper the calculations as to the height of the mountain, based on the data collected by Mr. Lightbody, had not been made. Its height had been previously estimated at from 22,421 to 25,000 feet.

Prof. Bonney, basing his remarks upon the geological collections

brought home by the party, said that while both Aconcagua and Tupungato are volcanic, the craters have wholly disappeared. From Aconcagua itself no scoriaceous specimens were brought back, and this fact combined with enormous precipices on the eastern side, leads him to suppose that beds of lava enter very largely into the composition of that peak. The present summit is either a dyke in the wall of the old crater, or else the actual lava plug which has choked up the bottom of it. Consequently the whole of the crater is gone, and that which was the lowest part is now the highest. So that it may be fairly assumed that one or more thousand feet once rose above the present top of Aconcagua.

SEALS IN A LABRADOR LAKE.—Mr. A. P. Low, of the Geological Survey of Canada, in his "Report on a Traverse of the Northern Part of the Labrador Peninsula from Richmond Gulf to Ungava Bay," says that in Seal Lake, fifty miles long and from a half mile to five miles wide, nearly 800 feet above the sea and about 100 miles distant from it, either the common harbor seal (*Phoca vitulina*) or a closely allied species, lives and breeds in considerable numbers, thirty or more being killed annually by the Indians. The seals are thought to have come into this lake during the Champlain submergence, which must have nearly or quite connected it with Hudson Bay; and having found it full of fish, they probably lost the inclination to return to the sea.

Mr. Warren Upham, commenting upon the above in the *American Geologist* (No. 5, 1898), says that this explanation, which is doubtless true, refers to a simple and somewhat uniform epeirogenic uplift less complex and less prolonged than the earth movements which will be found to account for the seals and many species of marine crustaceans in the great Siberian lake Baikal, about 1,500 feet above the sea and having a maximum sounding of 4,746 feet. In both these instances the connection with the sea was geologically recent, in contrast with the probably remote time when Lake Tanganyika, 2,680 feet above the sea and of undetermined depth exceeding 1,200 feet, received its jelly fish and numerous species of mollusks, prawns, and protozoa of marine derivation. Orogenic as well as epeirogenic movements with profound crustal deformation quite certainly shared in separating the basins of these greater fresh-water lakes from the ocean, giving to them a far more complicated history than that of Seal Lake, which merely participated with all the Labrador Peninsula in a general uplift from the late glacial or Champlain depression.

## EUROPE.

The Canal from the Baltic to the Black Sea.—The digging of the trans-continental canal which is to extend from Riga to Kherson, Russia, between the Baltic and the Black Sea, began last spring. Starting from Riga the route follows the Dwina River to Dunaburg. From this point the canal will be dug to Lepel upon the Berezina River. It will then follow this stream and the Dnieper to the mouth of the latter river. The route thus utilizes the river courses, and of its total length of 1,600 kilometres only about 200 will be excavated. To enlarge the commercial area to be served by the canal it is proposed to utilize numerous secondary rivers and thus connect the canal with the important towns of Mozyr, Chernigov, Jitomir, Poltava, etc. The canal will be open to vessels day and night. It will take six days for large river vessels to pass through it. Five years will be required to build the canal.

Dr. Thoroddsen Completes his Explorations of Iceland.—Dr. Thoroddsen, the well-known explorer of Iceland, writes to the *Geographical Journal* (Nov., 1898), that last summer he completed the geographical and geological researches in Iceland which he began in 1881. He has now examined the entire island. Last summer he investigated the high table lands, northwest of Langjökull in the northwest inland region, examining their physical geography and geology. In the beginning of August he went to the mountain regions behind the valleys of the Borgarfjord, west central coast, where he made some extended excursions.

Exploring Russian Lakes.—Ladoga and Onega lakes, among the largest in Europe, with a total area of nearly 28,000 square kilometres, although in the neighborhood of St. Petersburg, have never been adequately explored. Last summer the Imperial Geographical Society sent an expedition to these lakes to study the temperature of the water at various depths, and ascertain the contour of the bottoms and other peculiarities.—(*Verhandl. of the Ber. Geog. Soc.*, No. 7, 1898).

Caucasian Glaciers Retreating.—Prof. Muschketoff records the fact (*Izvestia*, *Imp. Russ. Geog. Soc.*, No. 4, 1897) that observations at eight glaciers in the Caucasus extending over a period of eight to ten years show that they are steadily receding. The termini of the glaciers are retreating from nine to thirty-eight metres every year.

Opening a New Russian Forest District.—Mr. Henry Albrow writes to the *Journal* of the Manchester Geographical Society, that the hitherto unavailable forests of the extreme northeast part of Russia in Europe are about to be made accessible, and within a short time the fine redwood trees of those virgin forests bordering on the Arctic circle will be put upon the English and other European markets in the shape of lumber. A commission has been granted to a strong Swedish company with cutting rights to fell about one million trees in the basin of the Petchora River, and arrangements have been made for transportation of the logs down to the mouth of the river and along the coast westward to the port of Oserka on the Murman coast, Kola Peninsula, within a few hours steaming of the Norwegian frontier. The mouth of the Petchora is free from ice and open to navigation for only three months in a year, but it is thought feasible to convey sufficient logs during that time to the saw-mills at Oserka to enable them to cut lumber practically the whole year. Oserka being an ice-free port, the export can be carried on during nine or ten months of the year. The redwood trees on the west slopes of the Ural Mountains in the Petchora basin are of excellent quality and large dimensions. The Petchora is navigable from its source on the western slope of the mountains to its outlet in the Arctic Sea opposite Novaya Zemlya, 700 miles. Navigation, however, is difficult in its delta. The new saw-mills at Oserka will have a sawing capacity of 300,000 logs a year and vessels can load alongside the quays.

## ASIA.

Exploring Southern Arabia.—One of the unexplored areas of the world is the interior of Southern Arabia. The Vienna Imperial Academy of Sciences (*Globus*, No. 16, 1898), has sent an expedition to explore this region and in particular to examine the extensive ruins in the Hadramut. The expedition will probably last from four to six months. This region was once a very important trade centre and associated with interesting phases of ancient history, and the expedition is expected to attain valuable results from the study of the ruins of the old civilization, as well as from its researches in geographical and geological science. The Academy has the coöperation of King Oscar of Sweden, who assisted it to secure in Stockholm the steamer Gottfried, 700 tons, which is equipped with all appliances for such a journey. Count Karl Landsberg, the Swedish Arabist, who long resided on the south Arabian coast and established friendly relations with some of the Sheikhs of

the interior, is the leader of the expedition, assisted by Dr. D. H. Müller, professor of Semitic languages at the University of Vienna. Dr. Alfred Zahn, Prof. Oskar Simony (son of the late Austrian geographer) and Dr. Franz Kossmat, of the Imperial Institute of Geology, a former pupil of Suess and Penck, are other members of the party.

Gold on the Coasts of the Okhotsk Sea.—The Russian Government has received a report from the expedition sent out under Mr. K. T. Bogdanovich to explore the east coast of Siberia from the town of Okhotsk to Chumikan, at the southwest corner of the Okhotsk Sea. Gold was found in paying quantities in a number of the rivers flowing into the Okhotsk Sea, and also on the slopes of the low mountain ranges which run almost parallel with the coast. Alluvial gold was found in several places which resembles that of the Amur territory and particularly that of the Seja basin. The cold climate is an impediment to mining. Midway on the coast is the hamlet of Ayan, whose excellent harbor is free from ice five months in the year.—(*Verhandl. of the Ber. Geog. Soc.*, No. 7, 1898.)

Caravan Routes in Persia.—Persia, which is about five times as large as Great Britain and Ireland, consists, for the most part, of an elevated plateau, intersected by barren mountain ranges which run east and west and die out near the eastern frontier. There are only a few rivers, and these are small. There is a large area of salt desert. Where there is water the fertility is prodigious. The population is sparse and probably does not exceed 7,000,000 souls. The route to Trebizond, on the Black Sea, is the only land-trade route to the west, and this used to be the main route for traffic to and from Europe till the near approach of the Russian frontier, and the import of Russian goods *via* the Caspian on the one hand, and the Suez Canal on the other, crippled its importance. Still, trade follows this route in spite of its passing through Turkey and the country of the unruly Kurds, and although its outlet on the Black Sea is off the highway of sea-borne traffic.

The average height of the Elburz range on the north is 11,000 to 12,000 feet, and the passes over it vary from 6,500 to 10,000 feet in altitude. It should naturally seem that trade routes would avoid the mountain ranges, which form the retaining walls of the Great Central Plateau on its northern and southern sides, and that they would enter Persia either from the east or west and so escape the main obstacles to a good road. From the east, however, south of

Herat, there has been no land traffic until recently. The Government of India is now encouraging a trade route from Baluchistan to Seistan Province in southeast Persia, and it is said to be proving a great success.

At present, merchandise and travellers are carried by means of either camels, mules, ponies or donkeys. These are formed into caravans. In the case of pack-animals, the load varies with the size and age of the beast. Packages of 200 pounds each, making a total weight of 400 pounds, is about the average camel-load. The camels are tied in long strings, the halter of each being fastened to the tail rope of the one before him. From fifty to sixty walk in a line at a pace of about two miles an hour.—(*Lieut.-Col. Henry Lake Wells in the Journal of the Manchester Geog. Soc.*, Nos. 4–6, 1898.)

## AFRICA.

Crossing the Sahara in a Balloon.—Lieut. Hourst, the explorer of the middle Niger, contemplates crossing the Sahara in a balloon. Starting from the Gulf of Gabes he hopes, with the help of the northeast winds, to cross the waste to the north bend of the Niger. He expects to be accompanied by the aeronautic experts, Léo Dex and Capt. Dides.

## POLAR REGIONS.

Of the various Arctic and Antarctic expeditions now in the field, very little has been heard.

The failure of the *Windward*, Mr. Peary's ship, to return by December 1st, establishes beyond reasonable doubt the assurance that she will not come south until next summer or fall. As the wintering of the *Windward* in the pack was one of the contingencies provided for, little need be feared for the safety of the ship's company, all of whom are picked men—Newfoundland sealers, accustomed to work in the ice.

While the return of the ship would have brought us definite news concerning the exploring party, her failure to return this fall allows the reasonable and encouraging conjecture that she reached so high a latitude before disembarking Mr. Peary and his party, that she was not able to clear the pack before the ice sealed the channels. Of course every degree of latitude passed by the *Windward* on her northern course means just so many miles of weary tramping saved to the explorers.

The captain of the *Hope*, S. W. Bartlett, a brother of Captain John Bartlett of the *Windward*, says in a recent letter:

"My brother informed me before leaving, that if the ship was all right, and it did not break up (in the ice) that he would abandon on the 20th of August. I hope they got up to Discovery Head. The ice was very heavy, and we had considerable trouble getting out of Port Foulke, but apparently there seemed to be no obstacle in their course to Cape Sabine. I am inclined to think that the season set in early. We found the young ice stiff in crossing Melville Bay on our way back, and the whalers that arrived at Dundee, September 25th, report heavy frost and that they at one time thought they were caught for the winter."

We get from the London *Times*, through its correspondent on board the *Fram*, details of the voyage of Capt. Sverdrup's expedition across the Atlantic, to Godhavn, Greenland, where it arrived July 30th.

Continuous headwinds and stormy weather drove the *Fram* out of her course, and well up under the Faroes and Iceland. From the report it would appear that the ship rolls violently and makes but little way against headwinds.

While off Cape Farewell, on July 19th, the *Fram* ran into the ice and for two days pushed her way between the pans, which were unusually abundant this season in that latitude.

Along the western coast of Greenland the conditions were not at all favorable. The ice kept the *Fram* out of Sukkertoppen, but she succeeded in reaching Egedesminde, where thirty-six dogs were taken aboard. More dogs were to be embarked at Godhavn and Upernavik, whence the course was to be shaped for Cape York.

Meteorological and other observations were commenced early on the voyage, and several enclosed messages had been thrown overboard before reaching the neighborhood of Cape Farewell.

The Scottish Geographical Society issued in October a "Special Antarctic Number." Many distinguished scientists set forth the reasons for believing that a well-equipped expedition to the Antarctic regions would yield most valuable results.

In the same number the acting editor, Mr. W. A. Taylor, presents a most interesting "History of Antarctic Discovery."

Despatches from Hobart, Tasmania, state that the British steamer *Ruahine*, which had arrived there, reported that on November 20th she spoke the steam whaler *Southern Cross*, bearing the Borchgrevink expedition to the Antarctic Continent. All on board were well.

The *Geographical Journal* for November has a letter from Mr. H. C. Russell, the Government astronomer of New South Wales, on the subject of the limitation of the Indian Ocean field of ice-

bergs between 40° and 90° East Long. and 40° and 50° South Lat.

He thinks that this limitation is perhaps rather apparent than real; the number of ships passing through that region making the number of *reported* icebergs greater than in tracks to the north or south, where comparatively few vessels pass. Another probable cause is the Antarctic current which sets to the south near Kerguelen. He concludes:

"I think these reports are too condensed. We want the icebergs for each month and each year plotted, each on a separate chart, with currents, winds and weather shown, and then a careful study of the whole would, I feel sure, help us very materially in grasping the whole difficulty of the *iceberg*; and my pet scheme, were the money available, would be to send a party of competent observers in a suitable steamer to go amongst the icebergs in latitudes used for commerce, and study them say for six or eight months."

## COMMERCIAL GEOGRAPHY AND STATISTICS.

THE COAL PRODUCTION OF THE EARTH IN 1894–96.—The total coal production in 1894 was 554,948,000 tons; 1895, 585,319,000 tons; 1896, 600,105,000 tons. Here are the figures for the three greatest coal-producing countries:

| | 1894. | 1895. | 1896. |
|---|---|---|---|
| England.......... | 191,290,000 | 192,696,000 | 198,487,000 |
| United States.... | 154,887,000 | 175,185,000 | 173,000,000 |
| Germany......... | 98,806,000 | 103,958,000 | 112,438,000 |

The coal production in the United States in 1897 was 198,257,000 tons. Of this amount Pennsylvania supplied by far the greater portion, 106,000,000 tons, or about 54 per cent. of the whole, 52,000,000 tons being anthracite. The next most important coal-producing States were Illinois, with 20,000,000 tons; West Virginia, 13,500,000 tons, and Ohio, with 12,000 000 tons. Alabama produced 5,900,000, and the smallest amount, 495 tons, was contributed by Nebraska.

THE INCREASE IN THE POPULATION OF EUROPE.—*L'Economiste* has an article on the growth of the population of Europe and its States in the decade 1887–97. The total population of Europe at the end of 1887 was 343 millions, and at the end of 1897, 379.7 millions, an increase of 36.7 millions, or 10.3 per cent. increase for the ten years, or 1.03 per cent. for each year. In 1887, 35 persons, on an average, lived in each square kilometre, and in 1897, 39 persons, or an increase in density in population in ten years of 4 persons to the square kilometre. The most densely peopled coun-

tries are Belgium, 200 to the square kilometre; the Netherlands, 133; Great Britain, 118; Italy, 104; Germany, 87; France, 72, and Switzerland, 71. Russia made the largest increase in the decade, 17.4 per cent., with 103.6 millions inhabitants in her European domain. Russia, however, Norway, Finland and Sweden are the States of lowest density of population.

Coffee in the United States.—The United States is the largest buyer of coffee. It consumes one-half of the total production, which is about 1,600,000,000 pounds a year. Since 1890, the importations of coffee into this country have averaged in value about $90,000,000 a year, two-thirds of which comes from Brazil. Porto Rico and the Hawaiian Islands, however, are very favorably situated for coffee culture, and our new colonies are likely to supply a considerable part of the demand.

The Population of Japan.—*Le Résumé Statistique de l'Empire du Japon* says the population of that empire is increasing with wonderful rapidity. It has grown from 38,000,000 in 1888 to 42,270,620 in 1895; due wholly to excess of births. The annual death rate is twenty to the thousand.

The Caravan Trade of Tripoli.—Malta, the distributing point for goods destined to the Mediterranean nations, is reached by steamer from Tripoli in fifteen hours. The coast line of Tripoli measures 1,200 miles and it has many excellent natural harbors. The country, however, is still closed against the introduction of higher civilization. Much of the soil is rich and would yield a variety of valuable crops, but the Government adheres to the policy of excluding foreign enterprise. Tripoli is the chief gateway for traffic with the interior of Africa. The starting points of caravans, Tripoli, Khoms and Benghazi, are 200 miles nearer the Sudan than Oran, Algiers, Philippeville or Tunis. Even the railroads that now connect Oran and Philippeville with Aïn-Sefra and Biskra cannot compete with Tripoli's routes. Through its depots for goods in the interior at Ghadames, Ghat, Murzuk and Aujila and its merchant houses familiar for generations with the demands and tastes of the Sudanese, Tripoli is more closely connected than any other north African territory with Central Africa. Fezzan, Jofra, Aujila, Jalo and Kufra are so many resting places for caravans. The Sudan from and including Baghirmi to the Niger depend upon Tripoli for their imports. The most important routes are those radiating from Ghadames.

The desert tribes afford protection to the caravans in return for regular stipulated payments. The caravan trade is entirely wholesale. Business houses of Tripoli have agents in the markets of the interior. European goods are delivered to these agents on the outward journey, and the produce of the districts is received by the caravans on the return journey. Open markets for the consumer are never held by the caravans in the Sahara and its oases, and very seldom in the Sudan. The retail trade is exclusively in the hands of the agents or dealers in the market towns.

The size of a caravan is from 100 to 1,000 camels. The caravan's arrival is announced a day or two in advance by a man on a riding camel, so that the dealers may have time to collect wares for barter. There are fixed rates for barter, and fresh camels may be hired at the chief centres in the desert. The goods are bought by the payment of cash or more frequently by barter. The goods consist of cotton and woollen cloths chiefly, besides red burnooses, beads, silk, amber, paper, drugs and tea. The chief goods received from the Sudan are ivory, ostrich feathers and hides, with some gold dust, india rubber, indigo, sulphur and medicinal plants.—(Dr. L. H. Grothe, *Deutsche Blätter*, Bd. XXI, Heft 2.)

The report of the British vice-consul on the trade of Tripoli for 1897 says that the estimated value of Sudan products received there in that year was $460,000.

The Tin Plate Industry.—By tin plate is meant a sheet of iron or steel varying in thickness from 22 to 30 wire gauge and coated with tin. The plates to be covered with tin are in several sizes, but the standard is 14 by 20 inches. The tin comes from several sources, of which the best are in Australia and the Straits Settlements. The latter furnish the most desirable tin, known as Banca tin. This is regarded as the purest, and is in consequence more sought after by the manufacturer of tin plate. For twelve centuries the Cornwall mines in England, which were discovered about 55 B. C., were the only source of this mineral. In 1240 tin was found in Bohemia. Five hundred years later, in 1760, the Banca mines were opened. In this century, Australia became a producer of block tin on a large scale. From 1872 tin was found in commercial quantities in New South Wales, Queensland and Tasmania. Tin has been found in several parts of the United States, but in no sense can this country be regarded as a producer of tin. The United States has always been a large consumer of tin plate. In 1892 this country took 60 per cent. of the English pro-

duction of the commodity. In recent years a remarkable falling off in the imports has occurred, owing to the tariff upon imported tin plate, the demand for the article now being largely supplied by American industry.—(*The Yale Review*, No. 3, 1898.)

Commercial Schools.—The increased attention that is being given to the study of commercial geography is shown by the text books now preparing in this country, France and Germany, in which special attention is given to the commercial feature. Chicago is to have a commercial high school with a course extending over several years, in which large attention will be paid to commercial geography. The Diet of Japan has this year passed a bill for intermediate commercial schools throughout the empire. Signor Ferdinando Bocconi has placed at the disposal of the Milan Polytechnic $80,000 for the establishment of an "Istituto superiore di commercio," or Commercial University, to be situated near the Polytechnic. It will aim to train traders of the first rank, and will give a diploma for proficiency in the study of the economic conditions and languages of the leading countries, chemistry, commodities, commercial geography, commercial, industrial and maritime law, customs and railroad legislation, banking, insurance and business methods.

# WASHINGTON LETTER.

WASHINGTON, D. C., DECEMBER 15, 1898.

WATERWAYS.—The abandonment of the Pennsylvania canals leading from the coal region, the rumored sale of the Chesapeake and Ohio Canal, and the giving up of the waterway across the Delaware-Maryland Peninsula, are coincident with the active discussion of the feasibility of deep waterways from the Lakes to the sea, and of the great interoceanic lines at Nicaragua and Panama. On one hand is the general recognition of the present unprofitable character of those arteries of commerce which a half century ago were the foundation of commercial success, and on the other the appreciation of the vital importance of waterways capable of floating the modern large merchant vessels. The tendency to wholesaling and to concentration is thus exhibited in the fact that small canal boats and small canals do not pay, while large waterways are desirable at almost any cost.

The report of the Nicaragua Canal Commission of the Department of State has not yet been presented to Congress, but enough is apparently known to the friends of the canal to justify their activity in pressing forward the superiority of this project over that at Panama. There appears to be no question but that a canal must be built at an early date. In the same manner the advocates of the improvement of internal commerce are urging the extension of the system of movable dams on the Ohio River to provide slack water navigation in times of drought. It has been pointed out that the commerce on this river already far exceeds in tonnage that of the main Mississippi and its other tributaries. The supporters of the project of a ship canal between the Ohio River and the Great Lakes have been somewhat set back but not wholly discouraged by the recent speech of Mr. Andrew Carnegie before the Pittsburg Chamber of Commerce, in which he points out that he was among the first to suggest that a deeper canal should lead from the waters of Lake Erie to the Ohio. Since then conditions have changed and his present opinion is that if we had a ship canal 15 feet in depth the lake steamers would not come to Pittsburg. He stated that he did not wish to appear even by silence to be considered a party to any attempt to entice private capital to invest in building a canal between Pittsburg and the Lakes, because he is convinced that this capital would be entirely lost.

On the more northern project of deep waterways through New York the engineers are continuing surveys, but have not as yet made their report. They are obtaining a valuable body of geographic information, particularly concerning the volume of the rivers and the height and character of the divides between prominent drainage basins.

Navigability of the Rio Grande.—The importance of exact geographic knowledge is well illustrated by the case now pending before the Supreme Court involving the question of navigability of the Rio Grande, particularly in that part of the river north of El Paso. Although the location of this stream is so well known on account of its forming the greater part of the boundary line between the United States and the Republic of Mexico, yet it is curious to note the erroneous conceptions popularly held concerning this stream. The scholar in the public school of the East who has seen a river like the Connecticut, Hudson, Delaware, or Susquehanna, probably pictures the Rio Grande as having a volume as large or larger than these, especially when on the map of the United States he sees its great extent from the mountains of central Colorado down through New Mexico along Texas to the Gulf. He is surprised and incredulous when told that at points above the middle of this course the waters have diminished to such an extent that the bed becomes nearly or quite dry, and that for months at a time the thirsty travellers may drive along or across the channel of this great stream hunting for water, not knowing even that they have passed beyond the river.

These facts are not often given in school geographies or even in more pretentious works, and the efforts of advocates to prove or disprove the navigability of the stream have demonstrated at least how little has been recorded concerning this great drainage system.

As a safe and permanent boundary between the two nations, the Rio Grande cannot be considered a success. Its bed—dry for miles through many months of the year—may be filled by the impetuous torrent which, checked by the mud and *débris* carried on its flood wave, cuts new channels, leaving many square miles of Mexican territory on the north of the deepest channel, or cutting off the communication of Texas ranchers from their native State. The torrents subsiding, the water gradually disappears, leaving wreckage along its course and a train of interminable controversies as to whether this piece of land or that is in Texas or in Mexico.

Navigation on a part at least of the Rio Grande is confined dur-

ing much of the year to "prairie schooners" * or similar vehicles. The Supreme Court of New Mexico announced that it is perfectly clear that the Rio Grande above El Paso has never been used as a navigable stream and that it is not now capable of being so used, more especially since dams have been erected and maintained at El Paso for nearly two hundred years, by which water has been taken out for irrigation on both sides of the stream. Nevertheless, this question of navigability, with other technical points, has been a matter of legal argument.

There is one point which perhaps appeals more to geographers than to the legal mind, and that is, that the main stream of the Rio Grande has been ignored in applying the name, as in the case of the Mississippi. With the latter it is often held that the name Mississippi should be applied to the Missouri and not to the part of the river from above St. Louis to St. Paul. With the Rio Grande the conditions are reversed; the main stream, if we consider volume of flow and geographic course, is really the Pecos, while that part above the mouth of the Pecos is to a certain extent an intermittent tributary, whose flow has only an occasional influence upon the trunk stream. This fact has been pointed out by Mr. R. T. Hill, who classes the upper Rio Grande with the innumerable lost rivers of the interior which, rising in the mountains, gradually lose their waters in the lower deserts. The Rio Grande belongs to this type, with the exception that it has cut through several desert ranges and at flood times contributes its waters to those flowing from the Pecos.

FLUCTUATIONS OF THE MISSISSIPPI.—The floods and low water of the Mississippi River are the resultant of forces distributed over the vast area of one and a quarter million square miles. The main stream may be regarded as a delicate instrument which in its pulsations responds to impulses given hundreds of miles away. The play of these forces has been beautifully described in a recent paper by Mr. James L. Greenleaf. He dwells upon the silent forces in the sunshine, air and water, which are continually at work with bewildering complexity, as shown by the rising and falling stream whose sensitive surface is the infallible recorder of them all. Taking a large view of the subject, he shows that throughout the year there are two waves of intensity which sweep across the great basin of the Mississippi from south to north. In the autumn all of the rivers have a tendency to reach the lowest point, and all begin to

* A popular name for the waggons used on the great plains.

rise toward the latter part of the winter. The increased flow is first shown in the southern rivers in January, and creeping northward the accumulation of waters is shown by the higher stages of the Ohio in late January and the Missouri and upper Mississippi in February, resulting often in the disastrous floods of this latter month. This early flood is due to the gradual increase of temperature, broadening from the Gulf toward the upper headwaters. The great bulk of the water comes from the southern half of the watershed, while yet the northern streams are locked in ice.

The high water thus produced by this temperature wave is often prolonged until the time when the rivers are again caused to rise by a similar wave of effective rainfall, which also seems to sweep across the country. Starting from the Gulf in late winter it travels slowly northward, climbing the plains to the western mountains. It has followed and lagged behind the earlier wave of melting, sometimes overtaking it, with disastrous effects to the low lands.

The subject of the floods of the Mississippi is now under investigation by a special committee of the Senate, and is exhaustively treated in volumes of evidence from citizens and experts in various lines. The point of greatest geographic interest probably is that the disastrous floods from the lower river occur at times when the headwaters in the Rocky Mountain region have not yet felt the influence of the advancing wave of temperature. These upper streams do not begin to swell until the high floods of the lower river have passed away, and their influence in prolonging the boating stage is therefore rather for good than for evil.

Basins of the Plains.—The High Plains of the West, lying well within the semi-arid region, are popularly known to have an almost perfectly level surface. Careful examination of this surface shows it to be covered with shallow basins, varying from those two to three feet in depth and with breadth twenty times as great up to those with a depth of nearly one hundred feet and a breadth of one or two miles. This remarkable condition has been described by Mr. Willard D. Johnson in a report as yet unpublished, and the origin of the remarkable features is discussed at length. He points out that the forces at work are probably those present elsewhere, but that their effects are masked or concealed by the erosion of more humid regions. These depressions, or basins, may be caused by unequal subsidence of the stream-built sands and gravels which form the plains, such as might occur through a slight rearrangement of the particles by percolating water, or they may be

due to actual removal by solution of particles, causing channels which when enlarged are broken by the weight of the overlying earth. Where the depressions are in the form of pits or funnels, there is little doubt but that sudden subsidence into caverns has taken place, but on the other hand Mr. Johnson has become satisfied that most of the depressions are of gradual growth, and that even in the majority of cases the so-called "buffalo wallows" are in their initial stage shallow saucer-like depressions, originating from gradual solution or removal of material lying within a few feet under the surface. Buffalo doubtless wallowed in such hollows, as water would necessarily collect there after subsidence had begun.

The most remarkable case of subsidence is that of a sink-hole which originated suddenly in March, 1879, near the town of Meade, in southwestern Kansas. There had been an old road directly across the site, and over this a waggon had passed on March 3. Returning 23 days later a deep, sharp-edged pit was encountered about 175 feet across. It is now oval in form, 215 feet in greatest diameter. Cracks of roughly concentric form surround the pit, the dimensions of the area thus affected being 525 by 375 feet. The depth in 1879 was stated to be 89 feet, but through the slipping in of the banks the depth has decreased to 54 feet. When first noted the water was 75 feet in depth, being higher than the adjacent water level. This is probably due to the fact that the roof fell into a cavern full of salt water, displacing this, and that later the water gradually percolated away until it reached the level of the surrounding saturated area. There is no salt in the adjacent ground water, but the underlying Red Beds are intensely saline. This is shown by a test well sunk on the rim of the pit, in which impure rock salt was found at a depth of 325 feet.

One of the most curious phenomena in connection with this pool is the occasional high temperature at the bottom. The surrounding ground water remains constantly at 59° F. The surface water in the salt pit has a varying temperature, as might be expected, since it is exposed to the sun. On one occasion when the surface temperature stood at 89° F. the bottom temperature was found to be 156° F., the water being apparently stratified according to density. Thus a swimmer on the surface of the water enjoys a comfortable temperature, but on assuming an erect position his feet will be almost scalded. After several cloudy days the temperature at the bottom of the pool fell to 98° F. and at the surface to 76° F. The extraordinary range of heat at the bottom of this salt

pool led to the sinking of the test well, above noted, on its margin. In this the temperature of the rocks was found to be normal, the increase from surface to bottom being only about 11° F. in 325 feet.

Forestry.—The annual meeting of the American Forestry Association was held in Washington on December 14, 1898. Hon. James Wilson, Secretary of Agriculture, was elected President, and Dr. B. E. Fernow, of Cornell University, Vice-President. Mr. Gifford Pinchot, of New York, who recently succeeded Dr. Fernow as Chief of the Division of Forestry, was elected Chairman of the Board of Directors of the Association.

This meeting marks the end of the sixteenth year of active work and agitation on behalf of a rational and businesslike conservation of the forest resources of the country. It has been a year full of results, some of which, coming after many years of weary effort, have been a matter of surprise to the friends of the forestry movement. At the beginning of the year a determined attempt was made by Western politicians to throw open the reserves and to undo all that had been accomplished. When it was found that public sentiment was too strong to permit this and that some form of protection of the public forests was proposed, the opposition suddenly vanished and in its place came importunities for new reservations, or in other words new offices to be filled, the new places not being within the classified civil service. A year ago foresters feared that all reserves would be abolished; now they have reason to guard against the too hasty creation of new reservations.

N.

# SEVENTH INTERNATIONAL GEOGRAPHICAL CONGRESS, BERLIN, 1899.

90 Zimmerstrasse, Berlin S. W., November, 1898.

The Sixth International Geographical Congress, held at London, has, by a resolution unanimously passed on August 3d, 1895, accepted the invitation of its German members to hold its next meeting at Berlin in 1899.

The Geographical Society of Berlin (Gesellschaft für Erdkunde zu Berlin), which is assisted by a General German Council, considers it its honorary task to carry into effect this resolution, and herewith cordially invites the friends and promoters of geography in all countries, and especially the members of all geographical societies and cognate scientific bodies or institutes, to assemble at the German Capital for the meeting of the Seventh International Geographical Congress.

The meeting of the Congress will take place from Thursday, September 28th, to Wednesday, October 4th, 1899. Before the beginning and after the close of the Congress, excursions will be arranged through such parts of Germany as may be of interest with regard to physical or economic geography. There is particularly contemplated on the part of the Geographical Society of Hamburg an invitation to visit that city under the auspices and with the sanction of the Senate of the Free and Hanse Town of Hamburg.

Communications respecting the fuller organization and the general programme of the Congress will be despatched as early as possible.

The subjects which may be treated or discussed at the Congress are embraced in the following groups:

1. Mathematical geography, Geodesy, Cartography, Geophysics;
2. Physical geography (Geomorphology, Oceanology, Climatology);
3. Biological geography;
4. Industrial and commercial geography;
5. Ethnology;
6. Topical geography, exploring travels;
7. History of geography and of cartography;
8. Methodology, school geography, bibliography, orthography of geographical names.

An exhibition will not be arranged on the part of the Congress. If any private exhibitions should be instituted, notice will be given hereafter.

The membership of gentlemen and ladies is acquired by payment of 20 marks (one pound or 25 francs). Members will receive all publications of the Congress free of charge. Ladies accompanying members are also admitted as Associates against payment of 10 marks (10 shillings or 12½ francs), but in this quality will have no right of vote and will not receive all the publications gratuitously; in all other respects they have the rights of Members.

Intending Members and Associates are particularly requested to intimate their intention on the annexed form as soon as possible, in order that their names and addresses may be registered and all subsequent communications concerning the Congress may be sent to them.

Subscriptions may be paid in advance. As soon as the money is received, a ticket for the meetings of the Congress will be sent to the subscriber. No person will be admitted to any meeting or social gathering without a ticket.

All those who desire to propose to the Congress the treatment of certain tasks or problems, or who wish to communicate results of exploration, or who intend to read papers on subjects of general and enduring interest, are requested to give notification thereof before April 1st, 1899, and to send their manuscripts ready for print not later than June 1st, 1899. The time allowed for each discourse or paper shall, as a rule, not exceed twenty minutes, but exceptions may be granted by the Presidency for subjects of general interest or importance.

According to preceding usage the English, French, German and Italian languages are admitted as languages of the Congress, and all papers must be written in one of them.

All propositions, applications, notifications and manuscripts of papers, which are addressed in due time to the Congress, will be submitted for examination to a special committee, and, if found suitable, incorporated in the general programme, so far as the time at disposal shall allow. If it is desired that full notice of any communication thus admitted be given in the daily bulletin, which is to be published during the meeting, an abstract of it, not exceeding 1,500 words, must be delivered before August 1st.

Any motion to be laid before the Congress must be formulated in writing and should be transmitted not later than June 1st, 1899.

All correspondence relating to matters of the Congress is to be addressed

*To the VII. International Geographical Congress,*
*90 Zimmerstrasse, Berlin S. W.*

Remittances are to be addressed

*To the Treasurer of the VII. International Geographical Congress,*
*Herrn H. Bütow,*
*90 Zimmerstrasse, Berlin S. W.*

THE GEOGRAPHICAL SOCIETY OF BERLIN.

GEORGE KOLLM,
Secretary General.

F. BARON VON RICHTHOFEN,
President

FORM OF APPLICATION.

*To the Seventh International Geographical Congress, 90 Zimmerstrasse, Berlin S. W.:*

The undersigned herewith applies for his inscription as a Member of the Seventh International Geographical Congress, and engages himself for the contribution of 20 marks (or one pound or 25 francs).

* Payment is made by post-office order.
* " " " " check.

Ladies' tickets are also desired......as Members at 20 marks.
......as Associates at 10 "

Name........................................

Title and Position............................

..............................

Address........................................

Date........................................

Please give these indications in legible hand and in such form as you desire for entry in the official lists of the Congress.

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* To erase what is not desired. Checks to be made out on "Deutsche Bank," Berlin, payable to the Treasurer of the Congress, Herrn H. Bütow, 90 Zimmerstrasse, Berlin S. W.

# MAP NOTICES.

BY

HENRY GANNETT.

Since the last notice, the United States Geological Survey has issued fourteen additional sheets of the topographic atlas of the country.

One only of these, Hempstead, is in New York. This, on a scale of 1:62,500, with a contour interval of 20 feet, is on the south shore of Long Island, southeast of Brooklyn, and represents an area sloping gently from the glacial hills of the interior to the coast marshes, which, in time, are partially protected from the sea by sand-bars.

Lying mainly in Maryland, but projecting slightly into adjacent States, are three sheets, Elkton, St. Mary and Frostburg. The first is upon a scale of 1:62,500, with contour intervals of 20 feet. It represents an area of low, rolling hills near the head of Chesapeake Bay.

The second, St. Mary, on a scale of 1:125,000, with a contour interval of 20 feet, represents the Bay and its shores northward from the mouth of Potomac River, a sinking land, with broad estuaries, the country rising on the west little more than 100 feet above the sea, while on the eastern shore it is all less than 20 feet, and most of the area is marsh.

The third sheet, on a scale of 1:62,500, with the same contour interval, shows an entirely different country. The Allegheny Front, here a cliff 2,200 feet high, crosses it from the northeast to the southwest corner. East of it are parallel ridges and valleys, the typical Appalachian structure, while west of it the country soon assumes the well-known aspect of the Allegheny plateau, a dissected plateau, with irregular drainage lines.

The region about Omaha and Council Bluffs is represented by a sheet entitled "Omaha and Vicinity." This is on a scale of 1:62,500, with a contour interval of 20 feet. The Missouri River traverses the area from north to south in a bottom-land varying from three to six miles in breadth, beneath bluffs 300 feet in height. It is joined by the Platte near the south margin of the region. The Missouri winds in broad curves through its bottom-lands, from bluff to bluff. Its frequent changes of course are shown by the numerous crescent-shaped lakes which dot the bottom-land. Four other sheets repre-

sent areas in Nebraska, York, Hebron, Superior and Scotts Bluff. The first three are near the middle of the State, and represent prairie lands, with little relief. The fourth is in the western part and shows a part of the valley of North Platte River, with Bad Land bluffs, 600 to 800 feet high, limiting it on the south.

In South Dakota are two sheets, Huron and Olivet, on a scale of 1:125,000, with a contour interval of 20 feet. These show part of James River Valley, a country of trifling, but irregular, relief, produced by glacial deposits. Across them flows James River in a narrow channel, 40 to 60 feet only in depth. The stream courses are few, and are but slightly cut below the level of the plain. It is evident that this region is in its infancy.

In Wyoming is one sheet, Sundance, on a scale of 1:125,000, with a contour interval of 50 feet. This includes the northwest portion of the Black Hills which are shown on the eastern part of the sheet, and part of the Bear Lodge mountains, in the northwest corner. Upon this sheet is a fine example of a volcanic neck, in the mountain known as Inyankara.

In California is one sheet, Dardanelles, on a scale of 1:125,000, with a contour interval of 100 feet. This represents an area in the high Sierra, the eastern portion of which has been heavily glaciated, and now presents a broken surface, with many sharp peaks, amphitheatres, and lakes. In the western portion the streams have cut heavy cañons in their descent from the higher mountains to the San Joaquin valley.

In Washington is one sheet, Mt. Stuart, representing an area on the eastern slope of the Cascade Range. It is on a scale of 1:125,000, with a contour interval of 100 feet. In the southern part is the broad valley of Yakima River, while the northern part is occupied by the rugged granite peaks and spurs of the Range.

The map of the United States, edition of 1898, just issued by the General Land Office, corrects a serious error committed in earlier editions, that of including the territory of Oregon in the Louisiana purchase. There was absolutely no excuse for this blunder, for the western limit of Louisiana has, for many years, been well established, but none the less we congratulate the Land Office on the correction.

The distribution and migrations of the American and Asiatic fur seal herds are shown most admirably on a map prepared by Mr. C. H. Townsend, of the U. S. Fish Commission. The two herds are entirely distinct in their habitat and range, the American having its home on the Pribilof Islands, and its winter range extending

down the Pacific coast nearly to San Diego, following the coast closely. The Asiatic herd, with its home on the Komandorski Islands, ranges in winter and spring down the Asiatic coast, nearly as far south as Yokohama.

The United States Geological Survey has issued in connection with Bulletin 154 (Gazetteer of Kansas), a map of Kansas, on a scale of 1:750,000, about 12 miles to 1 inch, on which the relief is expressed by contours of 100 feet. It is compiled in the main from the detailed atlas sheets. As exhibiting the broad features of a portion of the Great Plains this map is of much interest.

The *Geographical Journal* for June, 1898, contains a sketch map of southern Tunis, illustrating Sir Harry H. Johnston's journeys, scale about 40 miles to 1 inch, relief expressed by brown shading; also a map of a portion of British Central Africa, west of the Loangwa River, from a sketch survey by Cyril D. Hoste; scale 1:1,000,000, relief by brown shading; a sketch map of Lob Nor and the Lower Tarim River, from a survey by T. K. Kozloff, and a map of Northeast Nicaragua, from a survey by John M. Nicol; scale 1:1,500,000, relief expressed by hachures.

The *Geographical Journal* for October, 1898, contains several maps worthy of notice: (1) a sketch map of Tirah and surrounding country, scale 1:250,000, shaded relief, published to illustrate a paper by Sir T. H. Holdich; (2) Kavirondo, East Africa, scale 1,500,000, drainage and sketch contours, with routes of exploration, accompanying an article by Mr. C. W. Hobley; (3) a railway map of the Argentine Republic and Chile, scale 80 miles to an inch, and (4) a relief map of Chile and the Argentine Republic, scale 1:20,000,000, relief shown by three shades of brown. Both maps (3 and 4) illustrate Col. Church's paper on Argentine geography.

The *Scottish Geographical Magazine* for June contains a map of Armenia and Kurdestan, showing distribution of native tribes, to illustrate an article by Mr. Victor Dingelstedt.

The *Scottish Geographical Magazine* for July contains a map of western Canada, showing routes of travel to the Klondike district, to accompany a paper by Mr. Wm. Ogilvie, scale about 100 miles to 1 inch. Also, in the same number, a series of four maps of Europe, representing various stages in the glaciation of that grand division.

Bulletin No. 10 of the Biological Survey, Department of Agriculture, contains as its frontispiece a small map of the United States, with adjacent parts of Canada and Mexico, representing the life zones of the country. They are classified as Boreal, Transition,

Upper Austral, Lower Austral, Gulf strip of Lower Austral and Tropical. These are subdivided as humid and arid.

The conformity of these zones to altitude and latitude, or, to sum it up, with temperature, is close, and yet examination of details shows notable departures. The Boreal zone is represented only in Canada, along our northern border and upon the higher of the Cordilleras; the Tropical zone only in southern Florida, southern Texas, the lower valley of the Colorado, and along the Mexican coast. The map is an instructive generalization.

*Istituto Cartografico Italiano. Atlante Scolastico per la Geografia Fisica e Politica di Giuseppe Pennesi, Roma, 1898.*

This physical and political atlas contains 50 plates, 5 of which are devoted to the earth as a whole, representing the relief, ocean currents, the elements of climate, the distribution of vegetation, population and religions. These are followed by physical and political maps of countries, of which Italy naturally claims the greater proportion of space.

The maps are beautifully engraved and printed, and the atlas is a very useful one for giving broad conceptions of the different classes of facts therein depicted. It is lamentable that American publishers cannot be induced to make similar atlases, giving corresponding prominence to our own country. H. G.

Senh. Ernesto de Vasconcellos publishes in the *Revista Portugueza Colonial e Maritima* of November a photogravure of an old map of Mombasa. In the margins of the plan is a description of the island, its capture and its restoration in 1728, which is approximately the date of the map. The reproduction is half the size of the original, which is drawn in colors, to the scale of half an Italian mile, of 60 to the degree. The water is colored greenish and shaded, and the fortifications are traced in carmine.

A comparison of the map with the recent Admiralty Chart of Mombasa shows only a few changes in outline, the natural result of the action of the water.

The most marked differences are in the breadth and the direction of the two streams, the Druma and the Arabaia, which enter the sea at the north end of the island.

G. C. H.

## BOOK NOTICES.

*Rivers of North America: A Reading Lesson for Students of Geography and Geology; I. C. Russell. G. P. Putnam's Sons, 1898. pp. xix + 327. $2.00.*

The fourth monograph dealing with the physical geography of North America that has just appeared from the pen of Prof. I. C. Russell is a handsome and very welcome volume, and by far the most important of the series. Up to this time we have had no popular or easily accessible consideration of the phenomena of rivers from the modern standpoint. All the adequate treatments, even for beginners in the science of geomorphology, have been in scientific periodicals, in part out of print. Prof. Russell has practically given us a text-book on the development of land forms, with particular reference to the work of rivers in North America, and has presented his facts in a well ordered and attractive way. The book is more inclusive, of more general value, and capable of broader usage than the title would indicate.

After a short introduction, the author considers the following large topics in separate chapters: The Disintegration and Decay of Rocks; Laws Governing the Streams; Influence of Inequality in the Hardness of Rocks on Riverside Scenery; Material Carried by Streams in Suspension and in Solution; Stream Deposits; Stream Terraces; Stream Development; Some of the Characteristics of American Rivers; The Life History of a River.

In Chapter II. we find a good treatment of the power and results of stream work, and a helpful consideration of peneplains and base-level of erosion. Chapter IV. considers in detail the complex problem of the loads of streams and degradation, particularly in reference to rate, both mechanically and chemically.

The last chapters are devoted more fully to the forms of land or waste due to river work. Alluvial cones, flood plains, deltas and terraces are treated fully as to origin, classification, and distribution. Many illustrative examples are mentioned, and references to literature are quoted.

Perhaps the most interesting chapter for a student of geomorphology is that on Stream Development. Here we have a well digested and very clear account of the development of consequent and subsequent streams on the more common land forms. Particular reference is made to the rivers of the Appalachians, and to

the details of river history which have been worked out in this region by our American geologists. We find the recently introduced and very helpful terms descriptive of different features of drainage, used in such a way that the beginner finds here the best available statements of the more necessary definitions. It should be stated further that the author has not included every term that has been suggested in the last few years, but only those which have appealed to others than the inventors, and which fill a need in our terminology.

The following chapter is devoted to a more concise account of our chief American rivers, given in such a form that it will be of help to the general reader and teacher, and should be much used for reference.

The last chapter is one of those mind-broadening considerations of earth forms and processes, from the earth rather than the human standpoint, that we have come to expect as the climax in Prof. Russell's monographs. The reader of this chapter should find himself becoming more and more in sympathy with the world about him, and more and more awakened to the pleasures of a scientific study of the earth and its relations to man.

The book is pleasing to the eye as to its form and typography, and well indexed. Our great regret is that the four monographs, dealing with the Lakes, Glaciers, Volcanoes and Rivers of North America are not uniform in appearance. Were they all printed after the manner of the last, they would form a library series as pleasing to the librarian as to the student of geography.

R. E. D.

*Leçons de Géographie Physique; A. De Lapparent, 2^me^ Edition: Masson, Paris, 1898. pp. xvi + 718.*

The very helpful *Leçons de Géographie* of Prof. De Lapparent has been so well received, and proved itself so useful, that a new edition has been issued in about two years from the date of the first. The book in question is indeed a *new* edition, for the author has re-written and amplified his former contribution very extensively. Two new chapters, one on the ocean and one on the classification of mountains, have been added, and the illustrations have been enriched by some 46 new cuts.

M. Emm. de Margerie has assisted in the work, and has made good use of his marvellous acquaintance with current geographic literature. It is undoubtedly due largely to his work that we owe so many references to Suess's *La Face de la Terre.* Indeed, the

references throughout the book are ample, modern and very well selected.

The introductory chapters, devoted to the origin and development of land forms, and treating of the work of the various constructive agencies, have nearly all been somewhat amplified and brought up to date. The greatest differences between the old and the new are found in the chapters devoted to what may be called Regional Geomorphology. In no part is the improvement and enrichment more noticeable than in the two chapters devoted to North America. The arrangement and treatment is here very new and satisfactory. We find a very adequate and helpful analysis of the features of North America, and particularly the United States, that has been made with the most modern results of American geographers in hand. The text here is helped by a number of well chosen plates, that are of service to an American as well as to a European reader. With Suess's *La Face de la Terre* as a collateral help, the student of comparative geomorphology has in this book a very ready source of reference. The more than 100 pages added to the first edition are a welcome and satisfactory addendum that make the book much more serviceable.

Perhaps the most pleasing feature to note is that while in America, the birthplace of so much that has had an important influence on the geographic thought of the world in the last few years, we are still without a manual in geomorphology, our French colleagues have not only produced a manual of great value, but have been obliged to have a reissue. We commend the spirit and work of our friends across the water, particularly this latest evidence of geographic progress. R. E. D.

*Cuba and Porto Rico, with the other Islands of the West Indies, their Topography, Climate, Flora, Products, Industries, Cities, People, Political Conditions, etc. By Robert T. Hill, of the U. S. Geological Survey. New York, The Century Co., 1898. 8vo, pp. 28 + 408, with index. 81 illustrations.*

This book is, as the title indicates, a geographic story of the West India Islands. It opens with a broad outline of the geography and oceanography of the Gulf of Mexico and Caribbean Sea, the American Mediterranean, as Mr. Hill aptly characterizes it, with its shores and islands. Taking up each of the larger islands in turn, he describes at length its coast, relief, rivers, valleys and plains, its climate and life, its population, government, industries and resources, the social condition of the people and its cities. To Cuba are devoted, in this way, 112 pages, to Porto Rico 40 pages,

to Jamaica 50 pages, and to Haiti 60 pages. The Lesser Antilles and the other smaller groups are of necessity treated more briefly. The work ends with chapters on "Geologic Features," "Race Problems," and the "Future of the West Indies."

Mr. Hill is a geographer, in the broadest and best sense. He has travelled extensively during the past 5 years in the region here described, studying its geology and geography, and the social and economic conditions of its inhabitants. As a result, we have in this book a masterly description of our new possessions and their neighbors, a live description born of the keen, sympathetic interest with which he has so recently studied them.

Not the least interesting part of the story is the great diversity of races found in these islands; the Spaniards, Cubans and blacks of Cuba, the mulattoes of San Domingo and the French-speaking negroes of Haiti, the blacks of Jamaica, with a slight sprinkling of English, and so on. The absence of intercommunication among these islands has led to curious phases of development or non-development of their peoples.

Regarding the Cubans Mr. Hill is optimistic, and many will not agree with him that the Cuban is of superior clay to his father, the Spaniard.

We regret to note the misspelling* of the name Puerto Rico in the title and throughout the book.

The dress of the book is pleasing; the print is excellent and the illustrations, half tones, are beyond criticism. H. G.

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* *Porto Rico*, it seems proper to say, is the true English name for the island of Puerto Rico. It holds its ground by the same right as Spain, Saragossa, Brittany, Belgium, Germany, Italy, Vienna and thousands of other names. The U. S. Board on Geographic Names, constituted in 1890, has made the form *Puerto Rico* obligatory in Government publications, and the changed relation of the island to the United States will give some extension to the use of this official spelling; but the right English name will remain, and the people of this country, spell as they may, will continue to pronounce *Porto Rico*.

Mr. Hill's work is that of a right-minded and conscientious man, making a true report of what he has seen and studied. His good faith and modesty are evident, and the reader hesitates to hold him responsible for the maltreatment of words and names. Such forms as Plaza *des* Armas (p. 64), Cape Mai*ci* (p. 132), *la* virazon (p. 52), might seem to be mere slips; but *Taçon* (pp. 66, 71) and El *Junki* (p. 133) disturb the mind with doubt. If any name is well known in Cuba it is that of Tacon, and the cedilla is as foreign to modern Spanish as to English. Does any one write Andrew *Jaçkson?*

The name of the flat-topped hill near Baracoa is El Yunque (the anvil). To spell it El *Junki* is to make an impossible Spanish word.

In the second edition, which must be called for, these faults should be corrected.

—EDITOR BULLETIN.

*Madagascar, Homère et la Civilisation Mycénienne. François du Mesgnil, Ingénieur Colonial. Deuxième Édition. Paris, Librairie Ch. Delagrave.* (1898.)

M. du Mesgnil adorns his title-page with a few words of soberness from Admiral Jurien de la Gravière. Considering the character of his book, he would have done better to quote Alfred de Musset:

> Je suis venu trop tard dans un monde trop vieux.

A book that takes Ulysses to Madagascar, and derives the names of Timbuktu, Tchad, Tanganyika and Nyassa from the Greek, should have been written in the happy time when scholars identified the English, the Mexicans and the Iroquois with the children of the Lost Tribes. To M. du Mesgnil the East is West and the West is East, and he finds no man to answer him:

> The names of the peoples who inhabited America before Christopher Columbus all have a Greek turn: Caribs, Aztecs, Zapotecs, Quelenes, Tzendanes. Did not the name of the Incas come to them from the distance, with respect to Greece, of the place which they inhabited: Incas, *Ekas*, far, very far? (p. 162).

*Die Reste der Germanen am Schwarzen Meere. Eine ethnologische Untersuchung von Dr. Richard Loewe. 8vo. Max Niemeyer. 1896. 8 mk.*

Dr. Loewe makes five divisions of his subject: the Germans of Asia Minor, the Germans of the Caucasus, the Germans reported on the Caspian, the Crimean Goths, the Gothi Minores, or Lesser Goths.

Theophanes, in the 8th Century, mentions the *Gotthograikoi* as taking part in a mutiny of the Byzantine fleet under Anastasius II. They reappear, as Dr. Loewe believes, in the *Graikoi* of Constantine Porphyrogenitus, in the 10th century, and he regards them as descendants of the Goths, Heruli and other Germanic tribes, who invaded Asia Minor in the 3d century.

In the anonymous Periplus of the Euxine it is recorded that the Eudusiani, living on the northern coast (between the modern Anapa and Gelenjik) speak the Gothic and Tauric tongue. There is room for conjecture in the statement since, according to Karl Müller, the editor of the Periplus, the text of that work is a compilation from various writers, and it is not even certain whether the expression, *Gothic and Tauric tongue*, is to be understood of one and the same language, or of two languages spoken by one people.

The name Eudusia does not occur again, but Dr. Loewe accepts Vassilievski's identification of it with the region called by Procopius

*Eulysia*, extending to the east of the Palus Mæotis, up to the river Tanais.

The same historian places the Tetraxite Goths on the north-eastern coast of the Euxine as well as on the Cimmerian Bosporus (Strait of Yenikale). The name Tetraxite is not of Germanic origin, and Dr. Loewe believes it to be a modification of *Tmutarakan*, often mentioned in the Russian Igor ballad, of the 12th century. In this ballad there is mention of Goths and Gothic maidens.

The earliest notice of the Crimean Gothic as a separate language is in the Slavic legend of St. Constantine, who betook himself to the Crimea in the latter half of the 9th century to preach Christianity. The Gothi, it is said in this legend, were among those who prayed in their own tongue.

The Fleming Rubruquis, who visited the Crimea in his pilgrimage, undertaken in 1253, noted there

> many Goths, whose language is Teutonic.

The characteristics, which neither Greek nor Slav was in a position to recognize, naturally impressed the man of a kindred race.

Dr. Loewe quotes several other writers down to the time of Busbec, from whose Epistolæ (Paris, 1589) he takes an interesting passage, describing an interview with two Crimeans,

> the one taller, with a certain openness and simplicity in his face, so that he looked like a Fleming or a Dutchman: the other shorter and more compact of body and of dark complexion, a Greek by birth and speech . . . .

Busbec wrote down from the dictation of the second a number of the Gothic words in use in the Crimea, and many of these are indisputably Teutonic, and nearest in form to Anglo-Saxon.

In one passage Dr. Loewe speaks of himself as only a layman, but he has treated an obscure and difficult subject with thoroughness and learning and in a winning style.

*In the Forbidden Land: An Account of a Journey into Tibet, Capture by the Tibetan Lamas and Soldiers, Imprisonment, Torture, and Ultimate Release Brought about by Dr. Wilson and the Political Peshkar Karak Sing-Pal. By A. Henry Savage Landor, with the Government Enquiry and Report, and other Official Documents by J. Larkin, Esq., deputed by the Government of India. With 1 Photogravure, 8 colored Plates, 50 Full-page and about 150 Text Illustrations, and a Map from Surveys by the Author. In two volumes. Harper and Brothers, Publishers, New York and London. 1899. 8vo.*

Mr. Landor's preface says:

> In this book I have set down the record of a journey in Tibet undertaken by me during the spring, summer and autumn of 1897. It is illustrated partly from my

photographs and partly from sketches made by me on the spot. Only as regards the torture scenes have I had to draw from memory, but it will be easily conceded that their impression must be vivid enough with me.

The map is my own, made entirely from my surveys of an area of twelve thousand five hundred square miles in Tibet proper. In Chapter VI. the altitudes of such high peaks in India as Nandi Devi and others are taken from the Trigonometrical Survey, and so are the positions fixed by astronomical observations of the starting and terminating points of my surveys at the spots where I entered and left Tibet.

According to the Government Report, signed by Magistrate Larkin, October 15, 1897 (Appendix, p. 217), Mr. Landor entered Tibet on the 13th of July, and was seized and bound by the Tibetans on the 20th of August.

The spring, summer and autumn journey was, therefore, a journey of a little more than five weeks in the summer of 1897. The time was short, but Mr. Landor made good use of it, not only in sketching and photographing, but in surveying and mapping an area of Tibet about equal to that of the Netherlands or the State of Maryland.

He submits, with deference, the following geographical results of his expedition:

The solution of the uncertainty regarding the division of the Mansarowar and Rakastal Lakes;

The ascent to so great an altitude as 22,000 feet, and the pictures of some of the great Himalayan glaciers ;

The visit to and the fixing of the position of the two principal sources of the Brahmaputra, never before reached by a European ;

The fact that with only two men I was able to travel for so long in the most populated part of Tibet.

Mr. Landor's solution of the uncertainty as to the lakes is that there is no connection between them.

Lieut.-General Sir Richard Strachey writes to *Nature*, of Nov. 24, that his brother, then Capt. Henry Strachey, crossed the stream that flows from Mànasarowar into Rakastàl and described it, in 1846, as about a hundred feet wide and three feet deep, running rapidly from east to west in a well-defined channel. In 1849 Lieut.-General Strachey himself saw the stream at the point where it leaves the lake, and there is no more doubt about the fact, he says, than that the Thames runs past Richmond.

Col. Sir T. H. Holdich writes, in the *Geographical Journal* for December (p. 588), that Mr. Landor has fallen into the inexcusable error of making a positive assertion about the physical conformation of the lake surroundings without having actually traversed the ground to which he refers.

Of the other results, so modestly claimed, it may be admitted

that it is something to reach an altitude of 22,000 feet and to take pictures of glaciers, as well as to travel with two companions in a more or less populous country. These feats are sometimes more interesting to the traveller who tells, than to those who read, his story, though they may be registered by courtesy as contributions to geography.

If Mr. Landor has really fixed the two principal sources of the Brahmaputra, he has done well; but it seems better to wait for more light on the subject.

Considered merely as a story of travel, *In the Forbidden Land* may be read with interest. It is fairly well written, and the account of the Tibetans has, except for some ghoulish tales, all the marks of truthfulness. They cannot be called an attractive people.

The most interesting portions of the book are the descriptions of scenery, the mountains, the snow-fields, the torrents bridged with ice, the plains and the mirage.

A great part of the second volume is taken up with the long-drawn details of Mr. Landor's capture, imprisonment and torture. It is not pleasant reading, and it might have been shortened with advantage. One obvious question remains without answer: why all this misery? Mr. Landor was warned, more than once, of the perils before him, and common sense refuses to admit the existence of a sufficient motive for his conduct. He was cruelly ill-treated; but he had no business where he was.

The illustrations, though too many of them are fanciful, are well brought out and the printing is good; but the paper could not well be worse. It is apparently loaded with clay and it splits, even when carefully handled.

*The Annals of the Voyages of the Brothers Nicolò and Antonio Zeno in the North Atlantic about the End of the Fourteenth Century and the Claim founded thereon to a Venetian Discovery of America.—A Criticism and an Indictment.—By Fred. W. Lucas, Author of "Appendiculæ Historicæ" and part Editor of "The New Laws of The Indies." Illustrated by Fac-similes. London, Henry Stevens Son and Stiles, 39 Great Russell Street, over against the British Museum. MDCCCLXXXXVIII. 4to.*

Vivien de Saint Martin, in his *Histoire de la Géographie* (pp. 387–388), has this to say concerning the story and the map of the Zeni:

Nicolo Zeno, of a noble and rich family of Venice, had, like so many of his countrymen, the passion for travel to distant places. He fitted out a ship, and steered from Gibraltar to the north. A storm which overtook him in the English seas drove him very far to the higher latitudes; he was cast upon a land which he calls *Frisland*. The king (a Norwegian) received him kindly, kept him and gave him

the command of his fleet, which was numerous. Zeno remained there fourteen years, part of the time with one of his brothers who had come to join him. Nicolo wrote many letters to his third brother, who had remained in Venice.

Some of these letters, found at a later day in the family, have been published, together with a map, drawn by Nicolo himself, of the pàrt of the Northern sea which extends above Scotland and west of Norway. Notwithstanding the incorrectness of direction and of position, the lands marked on this map are easily recognized. Above Scotland (*Scocia*) towards the northwest, is a large island, with the name of *Frisland*, which gave occasion formerly to so many erroneous suppositions and discussions; it is the group of the Faroe Islands, and the Venetian map presents moreover many details of denomination belonging to these. *Estland*, between Frisland and Norway, answers to the Shetland Isles. To the north of Frisland is Iceland, and above Iceland, to the north and west, appears Greenland, very well drawn under the form of a great mountainous peninsula, covered on its two coasts with names of streams and of capes, and designated by the double name of *Grolandia* and Engronelant. Finally, south of the point of Greenland, two islands, half hidden on the border, *Estotiland* and *Droceo*, evidently indicate the lands seen by Ericson and formerly described under the names of Helluland and Vinland. The document is explained by itself on inspection, and hardly required the academic erudition which has been expended upon it.

Mr. Lucas does not agree with this conclusion. He has devoted a vast amount of time and study and ingenuity to refutation of the arguments of those who are disposed to accept the Zeno story as an authentic record. His description of his work as a criticism and an indictment is exact, and, through no fault of his own, he leaves the main questions—whether the story is true and whether the map is to be accepted as genuine—still undetermined.

His own conclusions, somewhat condensed, are:

1. That, though Nicolò and Antonio Zeno may have visited Frislanda and written letters, the narrative was compiled by Nicolò the younger from the published works of others.

2. That the two accounts of Greenland are untrue and could not have been honestly written by persons who had visited it.

3. That there is no evidence that Antonio Zeno ever visited America.

4. That Columbus and Juan de la Cosa knew nothing of Frislanda.

5. That Frislanda had no real existence.

6. That Zichmni cannot be identified.

7. That the *Carta da Navegar* was made up from other maps.

8. That the Zeno story was compiled to gratify family pride and Venetian jealousy of other nations, by showing that Venetians had discovered America before the Genoese Columbus.

9 and 10. That Nicolò the younger was guilty of a successful imposture.

It must be acknowledged that these are not unreasonable conclusions; but they are not decisive; and the counsel for the defend-

ant, if there were one, could make an equally good showing. Nos. 1 and 7, for instance, assume too much. It is rash to conclude that original letters and maps do not exist, because they have not yet been produced.

The truth is that the evidence, whether for or against the Zeno story, is insufficient. The case must be left as it is.

Mr. Lucas's volume is admirably printed on excellent paper, and illustrated by eighteen maps and figures in the text and as many large reproductions at the end of the book.

*Cave Regions of the Ozarks and Black Hills. By Luella Agnes Owen, Membre titulaire de la Société de Spéléologie, and Fellow of the American Geographical Society. Cincinnati. The Editor Publishing Co. 1898.*

Miss Owen has visited the natural wonders of which she writes with an enthusiasm directed by study and knowledge.

The finest cavern of Missouri is Marble Cave, in Stone County. The entrance is through a large sink-hole in the top of Roark Mountain, and the descent over broken ground and by a wooden stairway lands the traveller at the Auditorium, the great chamber, thus described:

> The blue-gray limestone walls have a greater charm than those of an open cañon, owing to the fact that they sweep away from any given point in long, true curves to form an elliptical chamber three hundred and fifty feet long by one hundred and twenty-five feet wide, with the vault above showing absolute perfection of arch, and measuring, by the survey, from its lowest to its highest point, one hundred and ninety-five feet . . . In addition to the artistic superiority of architectural form, its acoustic properties having been tested, it is found to be truly an auditorium.

The chief ornament of this hall is the White Throne, a mass of white and gold onyx, sixty-five feet in height and of about two hundred feet in circumference. Thirty feet behind the throne is a fluted column of onyx, about twenty feet high. This is known as the Spring Room Sentinel, because the Spring of Youth is just behind, being the first chamber on the left in Total Depravity Passage, a dangerous way of which next to nothing is known.

There is a commodity of names in the Ozark caves, but South Dakota is not easily outdone with its Saint's Rest, Cupid's Alcove and Chamber de Norcutt.

Miss Owen's conclusion as to the formation of the Dakota caves is that they are the result of geyser action, and that the conical or dome shape of some of the chambers is due to jets of water forced up from lower levels.

The illustrations present some very striking forms, and a map at p. 42 gives a clear impression of the extent of Marble Cave.

## ACCESSIONS TO THE LIBRARY.

### October–December, 1898.

BY PURCHASE.

L'Afrique Equatoriale, par le Dr. A. Poskin, Bruxelles (1898), 8vo; Madagascar, Homère et la Civilisation Mycénienne, par Fr. du Mesgnil, Paris, 1898, 2me Édition, 8vo; Introduction to the Study of North American Archæology, by Cyrus Thomas, Cincinnati, 1898, 8vo; Through Romany Songland, by Laura Alexandrine Smith, London, 1889, 16mo; Historic and Monumental Rome, by Charles Isidore Hemans, London, 1874, 8vo; The Jesuit Relations and Allied Documents, edited by Reuben Gold Thwaites, Vols. XXIX–XXXIV, Cleveland, 1898, 8vo; History of the Catholic Church in the United States, 1843–1866, by John Gilmary Shea, New York, 1892, 8vo; The Sailor's Word-Book, by W. H. Smyth, London, 1867, 8vo; St. Paul, the Traveller and the Roman Citizen, by W. M. Ramsay, 4th edition, London, 1898; American Book-Prices Current, 1898, compiled by Luther S. Livingston, New York, 1898, 8vo; Proceedings of the Virginia Historical Society, Vol. XI, Richmond, 1892, 8vo; The Philippine Islands and their People, by Dean C. Worcester, New York, 1898, 8vo; Norway and the Norwegians, by C. F. Keary, London, 1896, 8vo; Sailing Directions of Henry Hudson, Introduction, etc., by B. F. De Costa, Albany, 1869, 8vo; Manuel de l'Explorateur, par E. Blim et M. Rollet de L'Isle, Paris, 1899, 8vo; In the Forbidden Land, by A. Henry Savage Landor, New York, 1899, 2 vols., 8vo; Emin Pasha, His Life and Work, by Georg Schweitzer, Westminster, 1898, 2 vols., 8vo; Yesterdays in the Philippines, by Joseph Earle Stevens, New York, 1898, 8vo; With Ski and Sledge over Arctic Glaciers, by Sir M. Conway, New York, 1898, 8vo; The American Democrat, by J. Fenimore Cooper, Cooperstown, 1838, 12mo; Things as they are in America, by W. Chambers, Philadelphia, 1854, 16mo; Insulinde, by Anna Forbes, Edinburgh, 1887, 8vo; Two Years Among the Savages of New Guinea, by W. D. Pitcairn, London, 1891, 8vo; The Boers in the Transvaal, 1880–81, by C. L. Norris-Newman, London (1882), 2d edition, 8vo; Journey to the Source of the River Oxus, by John Wood, new edition, London, 1872, 8vo; Private Life of Warren Hastings, by Sir Charles Lawson, London, 1895, 8vo; Les Actes des Apôtres Modernes: Voyages des Missionaires Catholiques, Paris, 1852, 3 vols., 18mo; Belgium and Western Germany in 1833, by Mrs. Trollope, London, 1834, 2 vols., 12mo; Promenade en Amérique, par J. J. Ampère, Paris, 1856, 2 vols., 8vo; Travels of a Naturalist in Japan and Manchuria, by Arthur Adams, London, 1870, 8vo; The Anglo-Saxon Home, by John Thrupp, London, 1862, 8vo; Memoria sobre Filipinas y Joló, por Patricio de la Escosura, Madrid, 1882, 8vo; Voyage de la Corvette La Bayonnaise dans les Mers de Chine, par Jurien de la Gravière, Paris, 1885, 2 vols., 8vo; El Archipiélago Filipino, por José Montero y Vidal, Madrid, 1886, 8vo; Voyage Round the World, 1803–1806, by A. J. von Krusenstern, 2 vols. in 1, London, 1813, 4to; Nieuw Guinea, Ethnographisch en Natuurkundig, Amsterdam, 1862, 8vo, and Atlas, 4to; Les Philippines, par J. Mallat, Paris, 1846, 2 vols., 8vo; Diccionario Geografico, Estadistico, Historico, de la Isla de Cuba, por Jacobo de la Pezuela, Madrid, 1863–67, 4 vols., 4to; Journal of an Exploration in the Spring of the Year 1750, by Thomas Walker, Boston, 1888, sq. 8vo; Flowers and Fruits; or, Thirty-six Years in Texas, by Z. N. Morrell, Boston, 1873, 16mo; Narrative of the Late Expedition to the Dead Sea, from a Diary, etc., edited by Edward P. Montague, Philadelphia, 1849, 12mo; The City of New York in the Year of Washington's Inauguration, by Thomas E. V. Smith, New York, 1889, 8vo; Incidents of a Trip through

the Great Platte Valley, New York, 1867, 12mo; The Black Man; or, Haytian Independence, by M. B. Bird, New York, 1869, 12mo; Through Asia, by Sven Hedin, New York, 1899, 2 vols., 8vo; With Kitchener to Khartoum, by G. W. Steevens, New York, 1898, 8vo; La Vie à Madagascar, par Henry Mager, Paris, 1898, 8vo; Geschichte der Isländischen Geographie, Th. Thoroddsen, Band II, Leipzig, 1898, 8vo; Almanach de Gotha, 1899, Gotha, 1899, 8vo; Atlas National Illustré des 86 Départements et des Possessions de la France, par V. Levasseur, Paris, 1849, folio; Journey from Madras through the Countries of Mysore, Canara, and Malabar, etc., by Francis Buchanan, London, 1807, 3 vols., 4to; Travels in Italy, Greece, and the Ionian Islands, by H. W. Williams, Edinburgh, 1820, 2 vols., 8vo; The Human Species, by A. de Quatrefages, London, 1879, 8vo; Nieuwe Geographische Nederlandsche Reise-en Zak-Atlas, etc., Te Amsterdam, 1773, 8vo; Atlas portatif à l'usage des voyageurs dans l'Oberland Bernois, Bern, 1816, 8vo; Voyage Pittoresque dans les Pyrénées Françaises, etc., par J. A. Cervini, de Macerata, à Paris, 1826–1830, folio; Royal Dictionary: English and French, by Fleming and Tibbins, Paris, 1841–1844, 2 vols., 4to; Behramji M. Malabari, a Biographical Sketch, by Dayaram Gidumal, London, 1892, 8vo; The Burman, his Life and Notions, by Shway Yoe, London, 1896, 8vo; The History of Cholera in India, 1862 to 1881, by H. W. Bellew, London, 1885, 8vo; Volcanoes of North America, by Israel C. Russell, New York, 1897, 8vo.

GIFTS.

*From Daniel G. Brinton, Author:*

The Linguistic Cartography of the Chaco Region, Philadelphia, 1898, 8vo; A Record of Study in Aboriginal American Languages, Media, Pa., 1898; On Two Unclassified Recent Vocabularies from South America (reprint), 1898.

*From the Century Company, Publishers:*

Cuba and Porto Rico, with the Other Islands of the West Indies, by Robert T. Hill, New York, 1898, 8vo.

*From Henry Gannett, Author:*

The Aims and Methods of Cartography, with Special Reference to Topographic Maps now under construction in Maryland. By Henry Gannett. (Special Publication, Vol. II., Part IIIa., Maryland Geological Survey.)

*From Walter R. T. Jones:*

The Stone Idols of New Mexico: A Description of those belonging to the Historical Society of New Mexico, Santa Fé, N.M., 1896, 8vo.

*From Jules Leclercq, Author:*

Voyage au Mont Ararat (reprint in Russian), par Jules Leclercq; Les Temples Souterrains de Ceylan, par Jules Leclercq. (Extrait.) Bruxelles, 1898.

*From the Lords Commissioners of H. M. Treasury, London:*

Report on the Scientific Results of the Voyage of H. M. S. Challenger, 1872–76, London, 1880–95, 50 vols., 4to.

*From Fred W. Lucas, Author:*

The Annals of the Voyages of the Brothers Nicolo and Antonio Zeno, etc., London, 1898, 4to.

*From E. L. Plumb:*

Map of the Caroline Islands. Published by the Royal Geographical Society, Dec. 12th, 1898, *sheet*, 20½ x 12¾.

*From G. P. Putnam's Sons, Publishers:*

The Rivers of North America, by Israel C. Russell, New York, 1898, 8vo.

*From Charles M. Taylor, Jr., Author:*

Vacation Days in Hawaii and Japan, Philadelphia, 1898, 8vo.

## NOTES AND NEWS.

In January, 1899, will be issued in this city the first number of a quarterly journal designed to promote the interests of anthropology in America. The subscription price will be $4.00.

Each number, consisting of about two hundred octavo pages, will contain original papers, scientific notes and news and a current bibliography of Anthropology.

The new publication will take the place of the *American Anthropologist*, under the same name, or one of two others: *The American Journal of Anthropology*, or *Anthropology.*

The editorial board is composed of Dr. Frank Baker, Dr. Franz Boas, Dr. D. G. Brinton, Dr. George M. Dawson, Dr. George A. Dorsey, Prof. W. H. Holmes, Maj. J. W. Powell, Prof. F. W. Putnam, and F. W. Hodge, *Secretary and Managing Editor.*

The publishers will be Messrs. G. P. Putnam's Sons.

Popular Lectures in Geography.—The popular lectures for workingmen and women, given by the Board of Education of New York City, and managed by Dr. H. M. Leipziger, are now a very important part of the educational system of the city. The very large audiences, gathered from among all classes, listen with not only courteous, but interested attention. The people are not drawn together for amusement or from curiosity, but from a desire to be informed. The desire to know is very apparent in the majority of the faces that a lecturer meets in any part of the city.

Within the last two years Dr. Leipziger has planned courses at the various lecture centres so that a certain amount of concentration and continuity of thought is possible. This is well illustrated by the arrangements for the first course of lectures for 1898–99, running from October to January. Lectures are given at 38 different places in all parts of the Boroughs of Manhattan and the Bronx. At these centres 657 lectures will be given in the courses mentioned. Of these lectures, 207 will be on geographical subjects, usually in courses of 6, 8, 9, or 10 lectures each. 126 lectures will be given on the descriptive geography of different parts of the world, especially those parts now in the public mind; 55 lectures will be given on North America, and 20 on the United States. A course of six will be given in Anthropology.

The popularity and importance of geographical subjects is, we think, well shown by the proportion of time devoted to such sub-

jects. This is an encouraging thing for working geographers, and deserves a wider recognition. If such work can be sustained in a popular way, it will not be long before the parents of this city will be demanding better geography work in schools, and overturning the generally accepted feeling that *any one* can teach geography.

R. E. D.

THE CITY LIBRARY ASSOCIATION, Springfield, Massachusetts, will open in March, 1899, an exhibition of material relating to geography and geology.

The first purpose of this undertaking is to show the latest and best material for the use of instructors of all grades, from the primary school and kindergarten to the college and university. With this object in view the Association desires to secure copies of the best text-books, periodicals, maps, charts, relief maps, models, globes, lantern slides, collections of specimens, and devices of all kinds for teaching geography and geology.

Another and very important object of the exhibition is, to interest the general public in recent progress in the sciences of geography and geology and to demonstrate that progress, as far as possible, by the display of published results.

Special attention will be paid to a display of such material as will be of value to those who are interested commercially in foreign countries, and especially in the republics of South and Central America and in Mexico.

The exhibition will continue for several weeks.

DR. D. G. BRINTON has reprinted from the *Proceedings of the American Philosophical Society*, Vol. XXXVII, his paper on the Linguistic Cartography of the Chaco region. This paper, which is illustrated by a coloured map, supplements the pages devoted to the Chaco tribes in the author's volume on *The American Race* (New York, 1891). Another reprint is On Two Unclassified Recent Vocabularies from South America.

With these two comes a contribution to bibliography. Under the title of a *Record of Study in Aboriginal American Languages*, Dr. Brinton prints for private distribution a list of his writings on American linguistics to the number of 71, down to the month of October, 1898.

Students in this difficult line will recognize the value of such a list.

COLLECTIVE WISDOM is an excellent thing. The National Educational Association has adopted certain changes in spelling:

for programme, *program;* for though, *tho;* for although, *altho;* for thorough, *thoro;* for thoroughfare, *thorofare;* for through, *thru;* for throughout, *thruout;*

for catalogue, *catalog ;* for prologue, *prolog ;* for decalogue, *decalog ;* for demagogue, *demagog ;* for pedagogue, *pedagog.* (*The Educational Review, Nov., 1898, p. 402.*)

These mutilated words are not unlike the forms evolved by the deep mind of dauntless infancy, wrestling with the parts of speech; but they lack the charm of the child's performance.

The Alaska Geographical Society has just been organized at Seattle, Washington. Its field of activity is not limited, as might be inferred from its name, to the territory of Alaska, but embraces the world.

The new society desires to enter into relation and to exchange publications with similar associations at home and abroad.

The president is Arthur C. Jackson, F.R.G.S., and the secretary Prof. Frederick I. Monsen.

The Augustana College and Theological Seminary, Rock Island, Illinois, has brought out the first number of the Augustana Library publications, a paper on the Mechanical Composition of Wind Deposits, by Johan August Udden.

This is a careful study of observations on drifting sand, lee sand and atmospheric dust, illustrated by nearly forty tables.

The Ottawa Literary and Scientific Society, which was incorporated at the close of the year 1869, has just issued the first number of its Transactions.

The society is the outgrowth of the Mechanics Institute, founded in 1847, re-named the Bytown Mechanics Institute and Athenæum in 1853, and afterwards consolidated with the Ottawa Natural History Society. Besides the introduction and an historical sketch the papers in this first number are: The Name of Ottawa; The Violinist; Place Names of Canada; The Fur Seal of the North Pacific; The Yukon and its Gold Resources, and the Utilization of Moss Lands.

The article on Place Names presents, with many historical reminiscences, a bit of curious misinformation in the following foot-note on page 37:

> The evolution of the word "boss" is interesting. It was originally *base*—the man at the base; the man upon whom the enterprise rests. We say, "It rests with him to make it a success." The early Dutch on this continent used the word *Baas*, and the English sounding of "boss" soon came to spell it so.

The Dutch word *baas*, which means *master*, is in no way related to the English word *base.* According to the Introduction the city of Ottawa is without a public library, and this regrettable condition may have something to do with the confusion of ideas in the foot-note.

THE ROYAL GEOGRAPHICAL SOCIETY makes the following appeal on behalf of a National Antarctic Expedition:

A joint committee of the Royal Society and of our own society has been formed for the purpose of obtaining funds for the equipment of a National Antarctic Expedition.

The Fellows of the Society are so fully informed as to the many strong reasons for the exploration of the vast unknown Antarctic area, that it is unnecessary to repeat them. All the scientific societies in the Kingdom are unanimous as to the necessity for such an expedition, and the value of the results which would accrue. Her Majesty's Government have been urged to undertake the work, but while they do not see their way to do so directly, they have expressed their strong interest in, and approval of, the movement for obtaining the necessary funds from private sources.

There is no time to lose. In 1900 Germany will send out a fully equipped expedition for Antarctic exploration; and the scientific men who have been active in promoting the enterprise look to Great Britain for coöperation. The field is vast, and there is ample room for more than one adequate expedition.

Unless, then, this country is content to sit still and see herself superseded in a field in which she has hitherto held the foremost place, we must be assured of the necessary funds without delay. For an adequately equipped expedition, prepared to remain at work for two or three years, the sum of £100,000 is required. If the whole amount cannot be obtained, the Committee are resolved to do what they can with whatever funds may be placed at their disposal.

Out of the funds of the Society the Council contribute £5,000; a like sum is promised by Alfred Harmsworth, Esq.; the President, Sir Clements Markham, K.C.B., contributes £100; and smaller sums have been promised.

On behalf of the Council, I appeal to the Fellows for help according to their means; for, after the Government, the responsibility of maintaining the credit of the nation in this respect devolves upon the Royal Geographical Society more than upon any other body.

Contributions may be sent, to the credit of the National Antarctic Expedition, to Messrs. Cocks, Biddulph & Co., Charing Cross, S.W., or to the Society, 1 Savile Row, W.

CLEMENTS R. MARKHAM,
*President, Royal Geographical Society.*

1 SAVILE ROW, LONDON, W.
*November* 21, 1898.

THE XIXTH FRENCH GEOGRAPHICAL CONGRESS, which was held at Marseilles, in September last, made the following recommendations, among others:

That a detailed lithological and bathymetrical chart of the French submarine coast be prepared as promptly as possible;

That the number of hours allotted to geography in the scheme of secondary instruction be increased so as to give more importance to colonial geography and the geography of France; and that instruction in geography hold the same place in the classical as in the modern course;

That the Government proceed to put in execution, with the coöperation of private initiative and that of the municipalities and elected bodies, the plan for the organization of colonial instruction in a certain number of universities;

That a free port be created at Marseilles;

That the canal from the Rhone to Marseilles be begun, and that the Etang de Berre (in the Department of the Bouches-du-Rhône) be utilized;

That the works necessary to restore the navigability of the Loire be undertaken;

And that the plan for a canal between the Loire and the Garonne be perfected and executed;

That the geographical societies use their best efforts for the formation of departmental syndicates to arrest the destruction of forests, to restore them wherever desirable, and to protect the natural reservoirs of waters, such as lakes, ponds, etc., and prevent obstruction of the streams.

THE ANNALES DE GÉOGRAPHIE, for November 15, has a paper by M. Henri Lorin on the Congo Railway, which is destined, he thinks, to play a chief part in the economical and political history of Africa.

Large plantations are already in existence above Stanley Pool, and optimists declare that within ten years the Congo will produce all the coffee required by Belgium, and will have become one of the first markets in the world for cacao and tobacco.

Plans are now being made for the regulation of the rubber trade, so as to prevent the destruction of the trees and vines, and also for the protection of the elephant, now in danger of extermination by the ivory hunters.

The cost of transportation on farming implements, salt and rice, has already been reduced fifty per cent., and it is easy to foresee the day when other railroads will be built.

BUDAPEST IN 1896.—The Statistical Bureau of Budapest has published the detailed results of the census of the city taken on the 15th of November, 1896. Including the garrison of 16,220 soldiers, the population amounted to 617,856; an increase, since January, 1891, of 111,472.

Dr. von Körösy, the director of the Bureau, estimates the probable population on the 1st of July, 1900, at 685,340.

THE SINOPSIS ESTADÍSTICA Y JEOGRÁFICA DE LA REPÚBLICA DE CHILE, for 1897, estimates the area of the country at 753,216 square kilometres (290,828 square miles), and the population on the 31st of December, 1897, at 3,049,352*.

The foreign commerce of the Republic in 1897 amounted to a total value of 130,256,938 dollars, 18,185,281 dollars less than the total for 1896. The decrease is attributed to three causes: an

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* According to the U. S. Census of 1890, the State of Texas has an area of 265,780 square miles and a population of 2,235,500.

industrial crisis, a lower ruling price for mineral products, and a scarcity of capital.

The most important article of export is nitrate of soda, of which Chile has furnished in the 68 years, 1830–1897, the amount of 388,298,125 quintals (Spanish)=39,218,110,625 pounds.

The greatest exportation for one year was, in 1893, 27,285,205 quintals; that for 1897 was 23,970,789.

The death, on the 19th of November, of Commandant Bonetti, one of the oldest vice-presidents and most active members of the *Société de Géographie Commerciale*, of Bordeaux, is announced in the *Bulletin*, *No. 21–22.*

Lectures.—At the Annual Meeting, January 16, 1899, Mr. Edward C. Barnard, of the U. S. Geological Survey, will describe the Yukon Valley and the work of exploration by the party under his command in the Forty-Mile District, in the Klondike region.

On the 13th of February, Mr. H. M. Wilson, Topographer, U. S. Geological Survey, will address the Society on the Island of Porto Rico, its Topography and Aspects.

## OBITUARY.

### Don Francisco Coello de Portugal y Quesada.

It is with deep regret that we receive from the Geographical Society of Madrid the intelligence of the death, on the 30th of September last, of the eminent geographer, who was the founder of the Society and for so many years its honoured president.

Col. Coello belonged to the Corps of Military Engineers. He was an associate of the Royal Academy of History and a member of the Council for the Colonies.

An accomplished scholar and unwearied student, he was devoted to historical and scientific geography, to which he made many valuable contributions, only less known than his monumental Atlas of Spain.

The *Revue de Géographie*, for November, says of him:

> He was born at Jaen in 1822, and was graduated with the highest honours as a military engineer in 1839. In 1844 he was detached on special service in Algeria, with the rank of Captain of Engineers, and he spent a year with the French expeditionary columns. In 1858, having been appointed on the Statistical Commission, he was charged with the direction of the district Cadastral Survey. He attained the grade of Colonel in 1865 and became the director of the Government geographical, geodetic and geological surveys ; but he resigned his post the next year on account of difficulties which had arisen with the Prime Minister, Narvaez, and retired from the army.
>
> His work as a geographer is of the first order.

Col. Coello was elected a corresponding member of the American Geographical Society in the year 1894.

A Regular Meeting of the Society was held at Chickering Hall on Monday, November 14, 1898, at 8.30 o'clock, P.M.

President Daly in the chair.

The following persons, recommended by the Council, were elected Fellows:

Miss Mary Perkins Quincy, New Haven.
Percy R. Pyne (Life).
Samuel E. Stokes Allen, Holmesburg, Pa.
Joseph A. Marsh.
Charles Paul MacKie.

The President introduced Mr. George Byron Gordon, of the Peabody Museum, Cambridge, Mass., who gave an account of the work performed by the museum in the exploration of Copan, the ruined city of Honduras.

On motion, the Society adjourned.

A Regular Meeting of the Society was held at Chickering Hall on Monday, December 12, 1898, at 8.30 o'clock, P.M.

President Daly in the chair.

The following persons, approved by the Council, were elected Fellows:

W. F. Allen.
Walter Abbott, Boston, Mass.
Herbert Appleton.
Harry Alexander.
Charles P. Armstrong.
Thomas H. Bauchle.
George Coppell.
M. Dwight Collier.
Thomas J. Hurley.
Wolcott G. Lane.
James H. Bailey.
Luther G. Gadd.
George Holmes.
O. H. Kahn.
Newbold Morris (Life).
A. E. Piorkowski, Captain, I. G. Army.
Frederick A. Pell (Life).
Edward Stephen Rawson.
F. Brevoort Allin (Life).
Berkeley Balch.
James Harold Warner.
Miss Serena Rhinelander (Life).
William Shillaber, Jr.
Edgar C. Moxham.
Charles W. Zaring.
Donald McLean.
Felix M. Warburg.
John Ph. Voelker.
W. A. Underwood.
Louis P. Bayard, Short Hills, N. J.
William R. Warner, Philadelphia, Pa.
Charles H. Moss, Sandusky, O.

Joseph D. Redding.
Rev. A. F. Schauffler.
John E. Roeser.
George F. Seward.
George F. Brownell.
John V. L. Pruyn.
Almeric H. Paget (Life).
P. B. Weare, Chicago, Ill.
Charles M. Taylor, Jr., Philadelphia, Pa.
Edward A. Woods, Pittsburg, Pa.
James Steuart MacKie.
William Pennington, Paterson, N. J.

The President then introduced Mr. Cosmos Mindeleff, who addressed the Society on the subject of Aboriginal Architecture in the United States.

On motion, the Society adjourned.

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